EDISON AT HIS HOME, GLENMONT.

THE
LIFE AND INVENTIONS
OF
THOMAS ALVA EDISON

By W. K. L. DICKSON and ANTONIA DICKSON

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NEW YORK: 46 East 14th Street
THOMAS Y. CROWELL & CO.
BOSTON: 100 Purchase Street

PREFACE.

THE biography of Thomas Alva Edison is in response to the demand which the deep-seated public interest, called forth by the brilliant Edison inventions, has created for a knowledge of the person and life of this greatest of living inventors. It has been prepared under unique facilities for procuring fullness and accuracy of fact, and thence for creating a living and sympathetic picture of the man. The materials have been obtained from the observations of a close business and friendly association of the authors with their subject for a period of thirteen years, and from the verbal and written data which Mr. Edison has most freely and kindly supplied. To this should be added manuscripts from the leading members of the Edison staff and the inventor's private files of periodicals, covering over thirty years, and embracing the best work of American and Transatlantic journalism. Of all this material, careful and discriminating use has been made in this story, which is, therefore, the first full, accurate and, to Edison, satisfactory life yet given to the public. It has already partially seen the light in a serial contributed to *Cassier's Magazine*, and in an article upon the kineto-phonograph, which appeared in the *Century Magazine;* but these have received large and important additions, and are now, for the first time, gathered into one volume.

ORANGE, NEW JERSEY,
September, 1894.

ANTONIA DICKSON.
W. K. L. DICKSON.

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CHAPTER I.

EDISON'S ANCESTRY AND EARLY LIFE. PUBLISHING A NEWSPAPER AT FOURTEEN. HIS PERAMBULATING LABORATORY. TELEGRAPHING ON THE GRAND TRUNK RAILROAD.

THE present century is pre-eminently one of daring and potential intelligence. The new age, with its clearer thought, its wider scope of action, and its humane and liberal institutions, has proved itself an excellent foster mother for nascent ideas, and countless inventions, which, under mediæval auspices, must have been stifled at birth, as direct emanations from the evil one, have been nursed into being, and have attained a stature in keeping with the grandeur and breadth of perfecting humanity.

Released from the swaddling clothes of error and superstition, the inherent virility of man has reasserted itself, and to the untrammeled vision and ripened energies of the scientist, the arcana of nature have been gradually disclosed. Foremost amongst these has been the discovery of that most magical and mysterious potency, the electrical fluid. The prosecution of this comparatively crude and untried science was at first attended by laborious thought and imperfect results, and little progress was discerned until within the past half century, when the eyes of the

scientific world were opened to the vast resources and limitless adaptability of the new fields of thought.

Amid these improved mental conditions Thomas Alva Edison was born, and whilst it will be seen that his early career was attended by many painful hardships, his life, on the whole, may be considered a felicitous one, presenting, as it does, the spectacle of a man abreast of the times, and in touch with the progressive thought of the day.

Little is known regarding the remote ancestry of our hero, beyond the fact that his family was of Dutch origin, and emigrated from Amsterdam to America in 1737, where the grandfather of Samuel Edison, John Edison, attained an enviable celebrity as banker on Manhattan Island. There is reason to believe that the roll call might be extended back indefinitely, and fraught with the most interesting and creditable details, but the good-natured indifference of its most distinguished descendant has proven an insuperable bar to research.

The revolution brought with it as a necessary consequence, not only political upheavals, but social and commercial changes, little in keeping with the stately conservatism of substantial burghers. John Edison's sympathies were on the side of the Mother-Country, and his instincts antagonistic to anything which threatened his domestic or business serenity. He therefore withdrew from New York to Nova Scotia, where his grandson, Samuel Edison the second, father of Thomas Alva, was born. By this withdrawal from the field of action, John Edison proclaimed himself a United Empire Emigrant or loyalist, and became entitled, under the laws of Canada to a grant of territory, six hundred acres in size, with four hundred acres to his son, and half that amount to each of his son's children. To obtain possession of this land, some years later, John Edison landed at New York, June 14th, 1811, and made his way thence to Canada, through the wilderness, traveling, patriarchal fashion, in wagons drawn by oxen. After a painful

and tedious journey, he crossed the frontier and located himself in the township of Bayham, on Lake Erie.

Many years passed, but the concord which the Edisons had traveled so far to secure seemed an ever-receding goal. The political troubles generated by the rival elements of oligarchy and constitutionalism, culminated in the rebellion of the people in 1837 and 1838, under Louis Joseph Papineau, for Lower, and William Lyon McKenzie for Upper Canada. Samuel Edison the second, father of the inventor, was then keeping hotel at Vienna, Bayfield, having repudiated, with stern independence, the two hundred acres accruing to him from government. Smarting under the wrongs which he conceived to have been inflicted upon his party by the Tories, he joined the insurgents and rose to the command of Captain, under Dr. Duncomb. The enterprise proved a failure, and a general stampede ensued, principally to the United States, which magnanimously received the whilom malcontents. Among the proscribed was Samuel Edison.

Short was the shrift and swift the exit provided for unsuccessful patriotism. A long line of military executions and burning houses marked the progress of the triumphant party, and the majority of those who escaped judicial death perished in battle or were banished by Lord Dunham to the Island of Bermuda. Samuel Edison, however, was not minded to officiate as a sacrifice on the altar of Liberty or to stimulate the waning flames of patriotism by a libation of personal gore. Neither did he greatly stand on the order of his going. There were few locomotive conveniences at that date, and even had they been attainable, the strict incognito which Mr. Edison was under the necessity of maintaining would have precluded him from the enjoyment of these luxuries. Fortunately, however, for himself and for the later cause of progressive science, as embodied in his son, Samuel Edison's physique and training were singularly in his favor. Six feet tall and straight as an Indian, supple of muscle and strong of limb,

he ranked among the finest athletes of the day, and had no peer in swift and protracted running. These attributes served him well, and sustained him through a flight of one hundred and eighty-two miles, during which time he never slept, and dispensed almost entirely with food and rest. The river St. Clair was reached at last, and crossing to Marine City, our adventurer slackened his frantic speed and drew in grateful breaths from the land of moral and political freedom. The Edisons are a long-lived race, a fact from which we may deduce the most favorable prognostications for the hero of our tale. The inventor's grandfather lived one hundred and three years and seventeen days. His great-grandfather one hundred and two years and eight months, while one of his aunts achieved the illustrious record of one hundred and eight winters. At ninety Mr. Samuel Edison is vigorous of body and acute of mind. He lives much in the open air, tilling the soil of his Floridian home. His habits are regular, and his diet Spartan in its simplicity. As a natural consequence, he is saddled with few of the ills to which flesh is heir, and will probably furnish no exception to the longevity of his race.

Thomas Alva Edison was born on the 11th of February, 1847, at Milan, Erie County, Ohio. His mother, Nancy Elliot, was a native of Chenango County, a Canadian by residence and education, and a Scotchwoman by parentage. It will be seen, therefore, that the two national streams which have been most potential in determining the currents of the world's history—the Teutonic and the Celtic—met in the veins of our hero. Mrs. Edison was a woman of sweet and strong individuality, equipped with a solid, if unpretentious, education, acquired in the Canadian high schools, and endowed with rare abilities as a teacher. She was eminently qualified to deal with the plastic mind of her son, and it was to her judicious efforts, rather than to those of his father, that Edison owed that early impetus which gave such admirable scope and direction to his dawning powers. There is

a widely spread notion abroad that Edison is a rough and uncultivated man, devoid of early training, and educated simply from a business or scientific standpoint. Nothing could be more erroneous. Edison is a self-made and self-educated man, it is true, but for that very reason, his attainments are substantial and based upon an inherent love of study. Callow collegians, dragged through an uncongenial course of study, boarding-house graduates "steeped in a weak solution of accomplishments," ephemeral creatures, on whose glossy plumage the dews of Parnassus have no power to rest—these have formed themselves into a tribunal of final appeal, and their dictum has been accepted by the world at large. But the true facts are, that Edison, outside of the inventive vein by which he is exclusively known, possesses a mind virile, original and stored with varied and extensive information. At the age of twelve, a period when most boys are inflaming their imagination and perverting their moral sense with trashy and sensational fiction, Edison, partly from inclination, partly from over conscientiousness, was wading through such ponderous tomes as Burton's "*Anatomy of Melancholy*," Gibbon's "*Decline and Fall of the Roman Empire*," Hume's "*History of England*" and "*History of the Reformation*," Ure's "*Dictionary of the Sciences*," the *Penny Encylopedia* and "*Newton's Principia*." The latter work proved somewhat above his mental capacity, and had his lot

EDISON AT FOUR YEARS OF AGE.

been cast some two centuries earlier, he would probably have endorsed the attitude of the Newtonian audiences, who, on the testimony of the philosopher's amanuensis, went to his lectures in such small numbers and betrayed so little comprehension of him, that "oft times he did in a manner for want of hearers read to the walls."

Mystified by the obscure and technical language of the "Principia," Edison resorted to outside assistance, and received from the lips of a comparatively uneducated man such a simple and satisfactory explanation as to confirm him in his intolerance of mathematics as a basis for scientific instruction. "This man," says Edison, "explained the problem to me by the use of very simple language and without the employment of mathematics. I at once came to the conclusion that Newton could have dispensed his knowledge in a much wider field had he known less about figures. It gave me a distaste for mathematics from which I have never recovered. If I were asked to explain the phonograph to one unfamiliar with it, I would not display all the tools and machinery which are used in making the instrument. I look upon figures as mathematical tools which are employed to carve out the logical result of reasoning, but I do not consider them necessary to assist one to an intelligent understanding of this result."

Edison's literary proclivities were seriously hampered by the collapse of the family fortunes, and the early necessity of gaining his own living. A reduction of tariff on the Milan canal, owing to the construction of the Lake Shore Railroad, caused a widespread depression in commercial affairs, and so seriously undermined the social standing of Samuel Edison, as to force him to leave his picturesque home, and begin his life anew in the town of Port Huron, Michigan. This transpired in the year 1854, when Edison was only seven years old. Despite his paucity of years and the practical claims which life had already imposed, Edison devoted every spare moment to the improvement of his mind, and profited

to the utmost by the wise and gentle tuition of his mother. We suspect that his thirst for knowledge needed restraint rather than encouragement, if we may judge by the fact that he actually attempted to read through the entire Free Library at Detroit, and that he completed fifteen feet of closely serried volumes before his excessive ardor could be discovered and curbed.

THE BIRTHPLACE OF THOMAS A. EDISON, AT MILAN, OHIO.

Physically and mentally, this extraordinary youth seemed incapable of fatigue. To his teeming energies and prolific brain, rest and action were synonymous with stagnation, and his faculties only derived fresh lustre and vigor from his ceaseless round of toil. His next enterprise was as daring as it was original. It was in April of the year 1862. The hostilities between the North and South were at their height, and the press teemed with exciting

details, of which the battle of Pittsburg Landing, with its fifty thousand killed and wounded, formed an important item. Edison brought his winning ways to bear on the operators, controlling

"IN TWO MINUTES THE PRAYER MEETING WAS ADJOURNED."

the line, and by the tempting offer of a daily paper and two or three monthly magazines, obtained the use of the official blackboard for the publication of bulletins or headlines in advance of the expected trains and their literary freight. His next move

was to cajole the editor of the Detroit *Free Press*, Mr. William F. Story, out of a thousand copies of the paper, to be paid from the proceeds of the venture, and to induce the locomotive engineer to allow him a few minutes' grace at the various stopping places. Edison thus describes his triumphant progress: "At Utica, the first station out from Detroit, and about twelve miles distant, I usually sold two papers, our customary charge being five cents each. As we approached the station on this day, I put my head out to look forward, and thought I saw an excursion party. I had half a dozen papers in my hand. As we came nearer, and the people caught sight of me, they commenced to gesticulate and shout, and it suddenly occured to me that they wanted papers. I rushed back into the car, grabbed an armful, and when I got upon the platform I sold forty. Mount Clement was the next station. When it came in sight I thought there was a riot. The platform was crowded with a howling mob, and when the tones became intelligible, I realized that they were after news of Pittsburg Landing, so I raised the price of papers to ten cents, and sold a hundred and fifty where I had never before disposed of more than a dozen. As other stations were reached,

THOMAS A. EDISON AT FOURTEEN YEARS OF AGE.

these scenes were repeated, but the climax came when we got to Port Huron. The station there was a mile from the town. When the train stopped I shouldered my bundle and started for the city. When I got less than half way I met a crowd hurrying toward the station. I thought I knew what they were after, so I stopped in front of a church, where a prayer meeting was being held, raised the price to twenty-five cents per copy, and commenced to take in a young fortune. In two minutes the prayer meeting was adjourned, the members came rushing out, and if the way coin was produced is any indication, I should say that the deacons hadn't passed the plate before I came along."

This successful enterprise emboldened him to start a paper under independent auspices, and in the spring of the same year (1862) he purchased a disused lot of old type and stereos, formerly in the possession of the Detroit *Free Press;* fitted up a dilapidated freight car as workshop and editorial sanctum and burst upon the migratory world which flitted up and down the lines of travel with the *Grand Trunk Herald*, the first and last sheet ever published on a train. The novelty of the idea worked like a charm, and speedily sent the circulation up to four hundred, enlisting the good will of Stephenson, the famous engineer, and eliciting a cordial tribute of admiration from the London *Times*.

Encouraged by the success of his maiden effort, Edison extended his venture, and in conjunction with the "devil" of the *Port Huron Commercial*, started a sheet by the title of *Paul Pry*. This paper was mentally and mechanically superior to its predecessor, but unfortunately a boyish love of fun led the partners to indulge in a style of personality displeasing to the public, and the organ died with the immersion of the editor-in-chief in St. Clair River, at the hands of a stalwart and indignant subscriber.

Misfortunes, like birds, flock together, and the same year which witnessed the ignoble extinction of *Paul Pry*, saw the collapse of Edison's nomadic laboratory. The car in which his

OUR LUCKLESS HERO FOUND HIMSELF ON THE PLATFORM.

experiments were carried on was destitute of springs, and like the "one-hoss shay" of immortal memory, was in a complete and consistent state of decay. The constant jolting dislodged the cork of a phosphorus bottle, hurling it violently to the ground and setting fire to the car. The flames were extinguished without much difficulty, but the wrath of the conductor was less easily allayed. For many months past that gentleman's olfactories had been assailed by horrible scents and his auditory nerves invaded by alarming reports. He was therefore inclined to view Edison in the light of an unmitigated nuisance rather than in that of an interesting and incipient genius. The present crowning outrage gave him the revenge his soul had thirsted for so long, and in the twinkling of an eye, our luckless hero found himself on the platform with his household gods raining about his ears. The episode has served as a basis for innumerable comic sketches, literary and artistic, but to our minds the pathos of the situation has never been sufficiently recognized. Edison's local attachments were strong and his thirst for knowledge boundless. The battered

car, with its primitive equipments, was dearer to him than the faultless laboratory of the successful scientist, and its sudden dissolution was a terrible shock. In all the sorrowful vicissitudes of Edison's life, and they were many, nothing more desolate can be imagined than the figure of this ill-clad, ill-fed boy, standing irresolutely on the deserted road, the fragments of his cherished

HERALD.

THE WEEKLY HERALD.
PUBLISHED BY A EDISON.
TERMS.
THE WEEKLY Eight Cents Per Month.

LOCAL INTELLIGENCE.

[illegible]—We believe that the Grand Trunk Railway, give premiums, every 6 months to their [illegible], who use the least Wood and Oil, running the usual journey. Now we, have rode with Mr. E. L. Northrop, one of their Engineers and we do not believe you could fall in with another Engineer, more careful, or attentive to his Engine, being the most steady driver that we have ever rode behind (and we consider ourselves some judge, having been Railway riding for over two years constantly,) always kind, and obliging, and ever at his post. His Engine we understand likes not cost [illegible] for repairs [illegible] the other Engines do. We would respectfully recommend him to the kindest consideration of the G. T. R. Officers.

The more to do the more done—We have observed along the line of railway at the different stations where there is only one Porter, such as at Utica, where he is fully engaged, from morning until late at night, that he has everything [illegible], and in first class order, even the [illegible] the snow does not lie for a week after it has fallen, but is swept off before it is almost down, at other stations where there is two Porters things are [illegible] versa.

J. H. P. Hathaway runs a daily Stage from the station to New Baltimore in connection with all Passenger Trains.

Professor [illegible], has returned to Canada after entertaining delighted audiences at New Baltimore for the past two weeks listening to his comical lectures [illegible].

Didn't succeed—A gentleman by the name of Watkins agent for the Haytien government, recently tried to swindle the Grand Trunk Railway company out of sixty seven dollars the price of a valise he claimed to have lost at Sarnia, and he was well nigh successful in the undertaking. But by the indomitable perseverance and energy of Mr. W. Smith, detective of the company. The case was cleared up in a very different style. It seems that the would be gentleman while crossing the river on the ferry boat, took the check off of his valise, and carried the valise in his hand, not forgetting to put the check in his pocket, the baggageman missed the baggage after leaving Port Huron, while looking over his book to see if he had anything with him, but to his great surprise [illegible] telegraphed back stating so, but no baggage could be found. It was therefore given into the hands of Mr Smith, to look after, in the meantime Mr Watkins wrote a letter to Mr Tubmen, Agent at Detroit asking to be satisfied for the loss he had sustained in consequence, and refering Mr Tubman to Mr W. A. Howard Esq. of Detroit, and the Hon. Messrs Brown & Wilson of Toronto, for reference. We hardly know how such men are [illegible] in with such travelling villains, but such is the case, meantime Mr Smith, cleared up the whole mystery by finding the lost valise in his possession, and the Haytien Agent offered to pay ten dollars for [illegible] he has put the company to, and have the matter hushed over.

Not so, we [illegible] that the villian should have his name posted up in the various R. R. in the country, and then he will be able to travel in his true colors.

We have noticed of late, the large quantitys of men, taken by Leftenant Donahoe, 14 regt. over the G. T. R. to their rendevous at Ypsalanta, and on inquiring find that he has recruited more men than any other man in the regiment. If his energy and perseverance in the field when he meets the secesh, is as good as it was in his recruiting on the line of the Grand Trunk R. he will make a mark that the secesh wont soon forget.

Heavy Shipments at Baltimore—We were delayed the other day at New Baltimore Station, waiting for a friend, and while waiting, took upon ourselves to have a peep at things generally. We saw in the freight house of the GTR 400 bbls of flour and 150 hogs, waiting for shipment to Portland

BIRTH.

At Detroit Junction G. T. R. Refreshment Rooms on the 29 inst, the wife of A. Little of a daughter.

We expect to enlarge our paper in a few weeks

In a few weeks each subscriber will have his name printed on his paper.

Reason Justice and Equity, never had weight enough on the face of the earth, to govern the councils of men.

NOTICE.

A very large balance in [illegible] M. V. Edwards Waggon and Carriage shop, New Baltimore, Station. All orders promptly attended to. Particular attension paid to repairing.

FAC-SIMILE OF THE GRAND TRUNK HERALD—EDISON'S FIRST ENTERPRISE.

possessions around him, and in the gradually lessening distance the outlines of his beloved workshop and sanctum. Nothing in his subsequent career illustrates with greater force the indomitable nature of the man than his philosophic acceptance of the situation, and his prompt re-installation of himself and belongings in the cellar of his father's house at Port Huron.

Edison's experiments in telegraphy had inspired him with the desire of mastering the art completely, but his lack of funds and influence threw him almost entirely on his own resources. His new laboratory, located in the cellar of his father's house at Port Huron, had been fitted up with such fragments as had survived the writ of ejectment from the Grand Trunk line, and a work

RIDGEWAY STATION.

A daily Stage leaves the above named Station for St Clair, every day, Fare 75 cents.

A Daily stage leaves the above named place for Utica and Romeo, Fare $1,00.

OPPISITION LINE.

A Daily stage leaves Ridgeway station on arrival of all passenger trains from Detroit, for Memphis

UTICA STATION.

A daily Stage leaves the above named Station, on arrival of Accommodation Train from Detroit for Utica, Disco, Washington, and Romeo.

M'CLEMENS,

A daily stage leaves the above named station, for Romeo, on arrival of the morning train from Detroit.

THE NEWS.

Cassius M. Clay, will enter the army on his return home.

The thousandth birthday of the Empire of Russia will be celebrated at Novgorod in august.

"Let me collect myself" as the man said when he was blown up by a powder mill.

GRAND TRUNK RAILROAD

CHANGE OF TIME

Going West.

Express, leaves Port Huron 7.05 PM

Mixed For Detroit, leaves Pt Huron at 7,40 A.M

GOING EAST.

Mixed, For Pt. Huron, leaves at 4.00 P.M

C. R. Christie, Supt.

STAGES.

NEW BALTIMORE STATION.

Creek, and Newport.

MAIL EXPRESS.

For Baltimore, Algonac, Swan Creek, and Newport.

PT. HURON STATION.

An Omnibus leaves the station for Pt. Huron on the arrival of all Trains

LOST LOST LOST.

A small parcel of Cloth was lost on the cars The Finder will be liberally rewarded.

MARKETS.

Butter at 10 to 12 cts. per lb.

Eggs, at 12 cts. per doz.

Lard at 7 to 9 cents per lb.

ADVERTISEMENTS.

RAILROAD EXCHANGE.

At Baltimore Station.

SPLENDID PORTABLE COPYING PRESSES FOR SALE AT MT. CLEMENS ORDERS TAKEN, BY THE NEWS AGENT ON THE MIXED

TO THE RAILROAD MEN

Railroad Men send in your orders for butter, Eggs, Lard, Cheese, Turkeys, Chickens, and Geese.

FAC-SIMILE OF GRAND TRUNK HERALD—EDISON'S FIRST ENTERPRISE.

on telegraphy was purchased, which he studied diligently night and day.

His earliest experiments, made in conjunction with his friend James Ward, were primitive in the extreme, and brought the most crude materials into requisition. A line was constructed between the boys' homes, consisting of an ordinary stovepipe wire, insu-

lated with bottles, and crossed under a busy thoroughfare by means of an old cable rescued from the bed of the Detroit River. The first magnets were wound with wire, swathed in ancient rags, and a piece of spring brass formed the key. With a view to generating a current, and with a mind somewhat hazy on the score of static and dynamic electricity, Edison secured two Brobdingnaggian cats, with volcanic tempers, attached a wire to their legs, administered a violent amount of friction to their backs, and breathlessly awaited developments. Sad to relate, these zealous efforts ended in failure. The feline mind, concentrated on personal grievances, refused to lend itself to the pursuit of science, and the test resulted in a frantic stampede, enlivened by whoops and splutters. But, as Mr. Reid, in his memorial volume, remarks,

"The experiment was not without success; a tremendous local current and perfect electric arc were produced, but it would not work the line and was abandoned. The experiment illustrated the humor of the man."

"This incident," says his associate of many years, Mr. Edward H. Johnson, "is perfectly characteristic of the man. He will to-day undertake elaborate experiments and conduct them with great care and marvelous patience and perseverance, although his reason points to their utter futility. It is this trait, however, which led him into lines of original discovery and observation unattended by others."

Undismayed by these early failures, Edison steadily continued his investigations, and by denying himself everything but the barest necessities of life, found means to invest in a number of old instruments and other materials. He still pursued his ancient profession as news-vendor on the Port Huron train, and kept up a fairly brisk traffic with its nomadic population. Fortune favors the brave—in that lady's rare intervals of clearsightedness—and some two months after the events chronicled, Edison was the recipient of a gleam of capricious kindness. Human nature is much the

same in all ages, despite the accidents of birth and environment, and although the Nineteenth century has no dragons to slay and no enchanted princesses to rescue, it still affords scope for the dauntless heart and the ready hand. The exploit to which we refer occurred on the Grand Trunk Railroad, at the Mt. Clemens Station, Michigan, in the summer of 1862, and is described for this work by its most interested spectator, Mr. J. U. Mackenzie, station agent:

"Edison, or 'Al,' as he was then called, was at this time the newsboy of the mixed train, running from Port Huron to Detroit, and returning daily, Sundays excepted. He was at this period well on the road to success, and made it a point to leave at least one dollar of each day's earnings with his mother before starting on the following morning. Al had endeared himself to the station agents, operators and their families all along the line, and as the mixed train did the way freight work and the shunting at Mt. Clemens, they usually consumed not less than thirty minutes in doing it, during which time Al secured new patrons for his wares, visited and admired my poultry, or played with my little two and one-half year old boy Jimmy, of whom he seemed very fond.

"It was 10.30 on a lovely summer morning. The mixed train had arrived, leaving its passenger and baggage car standing on the main track at the north end of the station platform, the pin having been pulled between the baggage and first box car. The train, of some twelve or fifteen freight cars, had pulled ahead and had backed in upon the freight house siding, had taken out a box car (containing ten tons of handle material for Jackson State prison), and had pushed it with sufficient momentum to reach the baggage car without a brakeman controlling it. Al, who had been admiring the fowls in the poultry yard, happened to turn at this moment and noticed little Jimmy on the main track, throwing pebbles over his head in the sunshine, utterly unconscious of the

DASHING HIS PAPERS ASIDE, HE PLUNGED TO THE RESCUE.

danger he was in. Al dashed his papers (which were under his arm) upon the platform, together with his glazed cap, and plunged to the rescue, risking his own life to save his little friend, and throwing the child and himself out of the way of the moving car. They both landed face down in sharp, fresh gravel ballast with such force as to drive the particles into the flesh, so that, when rescued, their appearance was somewhat alarming. Examination, however, proved the injuries to be only skin deep.

"Tommy Sutherland, the train baggageman, who was an eye-witness, told me that had Al been a second later he would have

lost a foot or been killed, as the wheel of the car struck the heel of his boot. I was in the ticket office, and hearing a shriek, ran out, in time to see the train hands carrying the two boys to the platform. Being a railway employee on a very limited salary, and living, like the majority of railroad men, above my means, my salary was always spent before I received it from the paymaster, and having no other way of proving my gratitude to the hero, I made the following proposition to him upon the spot:

"'Al, if you will stop off here four days in the week and keep Jimmy out of harm's way until the mixed returns from Detroit (which you can do by getting Tommy Sutherland to bring your evening papers out for you, and as nine-tenths of your trade is between Mt. Clemens and Port Huron), I will teach you telegraphing and prepare you for the position of a night operator at not less than $25 per month.'

"He said, 'Will you?'

"I said, 'I will.'

"Extending his hand, he said, 'It's a bargain,' and we shook hands. Within a day or two the arrangement went into effect, and continued for about ten days very satisfactorily, when he absented himself for several days. When he turned up, however, it was to lay a complete set of working instruments before me that would not cover an ordinary envelope in size. They were perfect in their operation, and had been made by Al in the interim at the gun shop of Fisher & Long in Detroit, all of the work being done by his own hands. This set of instruments was used by him in Bill High's drug store, in the court house square down town, upon a line which Al and Rowland Benner constructed, connecting the station and the town by means of a line of annealed iron stove pipe wire upon the stakes of a stake and rider rail fence, and insulated by means of ordinary tenpenny nails. The line worked fairly in dry weather, but when damp or rainy, there was no tick to be heard.

"This line was his first speculation; a tariff of twelve and one-half cents was fixed, and the firm, during the first month, took in the enormous sum of thirty-seven and one-half cents, and then closed their doors, to enable Al to take the position of night operator at Stratford.

"Al made very rapid progress in telegraphing, as he had a fellow student in the person of Rowland Benner, Mrs. Mackenzie's brother, and each vied with the other in attaining proficiency. Al also received material aid from Bob Wagner of Detroit, Johnnie Thomas, G. T. Junction; Jack Mortimer, Port Huron; J. E. Smith, Agent Ridgeway, and others, all of whom deserve their share of any credit due to his instructors. At the expiration of three months he could teach me, and was quite eligible for the appointment which I secured him at the end of that time. He used to frequent the Western Union office in Port Huron, where he improved very rapidly, and it was during this period that he duplexed the Grand Trunk cable between Port Huron and Sarnia. This was considered a wonderful achievement, and greatly facilitated the business of the Grand Trunk Railroad at that point. I doubt if he was ever paid anything for this valuable work."

He remained at Port Huron three months, giving evidence of phenomenal industry and skill, of which one instance will suffice. The press at that time was on the *qui vive* to secure a correct report of the Presidential message to Congress, and offered the Western Union agent $60 to obtain it. Edison was deputed to receive it, with the promised reward of $20, but no sooner had the task been performed, with all the lad's accustomed ease, than the bargain was disowned, together with all claims for extra work. The greed and dishonesty of this man so disgusted Edison that he left abruptly for Stratford, Canada, in the capacity of night operator on the Grand Trunk Railroad, at a salary of $25 a month, a situation obtained at the instance of his friend, Mr. Mackenzie. The circuit manager was somewhat of a martinet;

MRS. NANCY EDISON, EDISON'S MOTHER.

and the service of the strictest, but Edison's ingenuity enabled him to evade at least one of the regulations without prejudice to the service. With a view to maintaining ceaseless activity during the drowsy hours of night, the operators were required to report the word *six* at intervals of half an hour.

This precautionary measure weighed with peculiar force upon Edison, from the fact that this erratic genius was in the habit of perambulating Stratford, its vicinity and the adjacent railway stations, returning in a semi-somnambulistic condition only just in time to resume his duties. Finding it impossible to keep his eyes open, and unwilling to relinquish his beloved wanderings, he conceived the brilliant idea of utilizing the clock as a substitute, which he did by constructing a wheel having notches cut at the outer edge, attaching the wheel to the clock and connecting it by wires with the main line circuit, with the result that the word "six" was regularly given. It was noticed, however, that Sf. could never be raised, just after "sixing." A detective operator was put on the track, with the result that young Edison and his labor-saving device were exposed. "That device," asserts Mr. Mackenzie, "is the District Telegraph of to-day, and was later perfected, patented and sold to the American District Telegraph Company.

It is possible that the temporary success of this device rendered Edison overconfident, for detection followed on the next evasion of duty. The operators were required, when so notified, to stop certain specified trains, and then to inform the train despatcher of their arrival. Edison, unaware of the limited time at his command, reversed the order, and notified the train despatcher before signaling the train, which passed through the station without stopping, and was nearly out of sight when he returned. Realizing too late the danger of the situation, he endeavored to reach a certain freight depot at the bottom of the station, knowing that trains often stopped there, and hoping to arrest their further progress; but the night was dark, the way

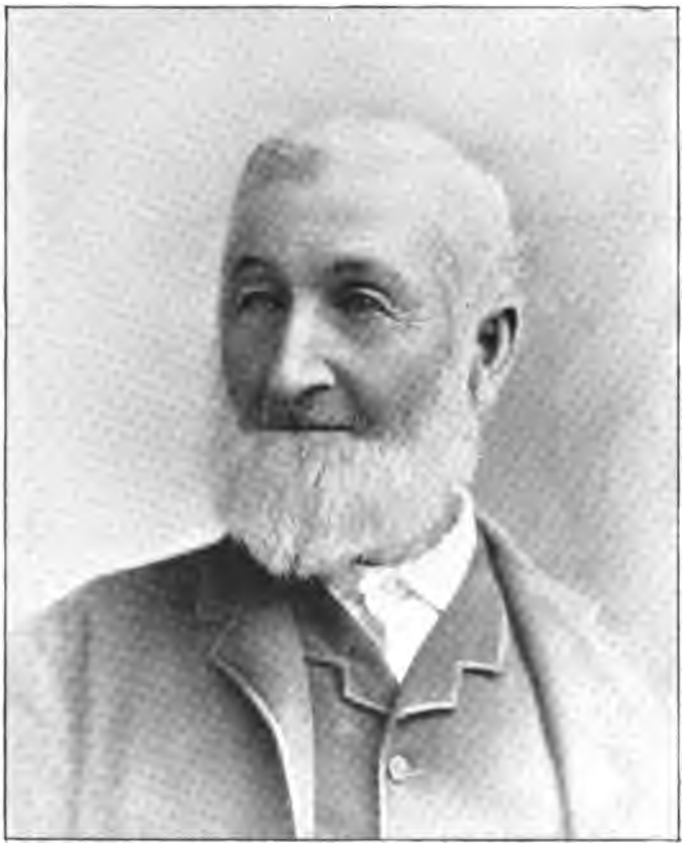
beset with obstructions, and the lad too fearful and agitated to see clearly. The result was that he fell into a culvert clearing, bruising himself severely, and occasioning a delay which enabled the train to pass entirely out of sight.

Bleeding and breathless, he presented himself at the telegraph office, and word was instantly flashed over the lines, but too late to have prevented the dreaded collision, which, however, did not occur, owing to the vigilance of the respective engineers. An infringement of duty so grave, and involving such fatal consequences, could not be allowed to pass unpunished, and Edison was speedily summoned to the presence of the general manager, Mr. W. J. Spicer, a very Rhadamanthus of icy severity. Edison thus describes the interview, infusing into it a spice of fun which was probably conspicuous by its absence on the occasion itself.

"'Young man,' said Mr. Spicer, 'this offense of yours is a very serious one, and I think I shall make an example of you. I can send you to the penitentiary for five years, and——'

"Just at this moment," continues Edison, "two English swells came in, and Mr. Spicer, now all affability, rose to greet them. They engaged him in conversation, and as I couldn't see that they really needed me around there, I slipped quietly out of the door and made for the freight depot, where I found a train about to start for Sarnia. I knew the conductor, told him I had been down in Toronto on a little holiday excursion, and said I'd like to take a run up the line with him as far as Sarnia. He told me to jump aboard, and I wasn't long in getting out of sight, but my pulse didn't get down to normal work until the ferryboat between Sarnia and Port Huron had landed me in the latter town. I haven't been in Toronto since that time, nor have I yet received the pay due me up to date."

Returned to Port Huron, Edison brought his newly acquired knowledge to bear on a novel set of circumstances. The winter had been an unusually severe one, and toward its close the masses



SAMUEL EDISON, EDISON'S FATHER.

of ice had formed in such bulk and with such tremendous force as to sever the cable between Port Huron and the Canadian city of Sarnia, rendering the river, which was a mile and a half wide at this point, totally impassable, beside impeding all telegraphic communications. Edison's exhaustless brain was stimulated by the demands of the situation, and jumping on a locomotive, he sent the incisive whistle over the ice-bound waters to the rhythmic cadences of the Morse alphabet—

"Hallo, Sarnia; Sarnia, do you get what I say?" No response from the Sarnian operator. Again and again the short and long toots shaped themselves into the dots and dashes of telegraphy, until at last, while the spectators on the river bank quivered with pent-up excitement, the answer came, clear, cheery and intelligible, and the connection between the two cities was resumed. This little episode, brief and simple as it was, brought the young operator into public view, and laid the foundation of his international fame.

Edison's abilities as an operator were now sufficiently well known to carry weight, and he had little difficulty in obtaining employment. Positions at Adrian, Mich., and Fort Wayne, Ind., were successively filled, and with considerable credit, although it must be confessed that Edison's love of fun and greater love of experiments led him to violate the essential rules laid down for the guidance of the operators. At Indianapolis these pleasing irregularities resulted in serious trouble, but his unpopularity and subsequent discharge probably weighed very little upon his mind, counter-balanced as they were by the fact that his increasing skill and deepened insight led him at the age of seventeen to the invention of a telegraph instrument, susceptible of transferring writing from one line to another without the assistance of an operator.

This automatic repeater is thus described in a recent telegraphic work as "probably the most simple and ingenious

arrangement of connections for a repeater known, and has been found to work well in practice. It is especially good and convenient where it is necessary to fit up a repeater, in an emergency, with ordinary office instruments." The ferment of discovery was now working in Edison's veins, militating against the steady, uneventful grind of daily routine. At an age when food and sleep are most essential to mental and physical development, he ruthlessly curtailed both, burning not only the midnight oil, but trenching on the gray hours preceding the dawn, a time when, as physicians tell us, vitality is at its lowest ebb, and most dependent on "nature's sweet restorer."

CHAPTER II.

THE DAWNING OF AMBITION. LIFE AS A TELEGRAPH OPERATOR. ADVENTURES IN INDIANAPOLIS, CINCINNATI AND MEMPHIS. PATHETIC DÉBUT AT LOUISVILLE. EDISON'S SKILL AS AN OPERATOR. COMPETITIVE ENCOUNTERS. PUBLICATION OF FIRST ELECTRICAL TREATISE. UTILIZATION OF SINGLE MARINE CABLE. ARRIVAL AT BOSTON.

THE strong impetus of ambition came with the sense of conscious power, and Edison bent his energies towards obtaining the successful control of a "report wire," the mastering of which bid fair to open avenues of increased influence and remuneration. He attained his end through the assistance of a fellow operator, a lad of kindred tastes and aims. Together the confederates worked and consulted with all the delicious mystery of inquisitorial familiars, and by the adjustment of two recording registers, the one for the reception, the other for the repeating of the embossed writing, they succeeded in obtaining "reports," remarkable for their perfect accuracy and clearness.

The manager, on being diplomatically approached, was induced to give the lads a trial of skill, and was so delighted with the results submitted, that he engaged the confederates for several weeks to supply the "copperplate transcriptions." At first the system worked smoothly and no delays were occasioned, but at the end of that time an unusual pressure of telegraphic matter made it impossible for the automatic repeater to keep pace with the despatches, and the numerous complaints from

newspaper offices which were laid before the manager next morning, resulted in that gentleman's personal investigation, a prompt suppression of the secret measures employed, and a summary discharge from the office. Thus, for lack of discrimination, the Indianapolis office was deprived of what, under certain judicious restraints, would have proved the highest order of skill and industry. These attributes were brought into early requisition during an engagement at Cincinnati, where he worked as day operator at a salary of $60 a month, supplementing his labors by night practice, whenever he could obtain the use of the wire.

One day a delegation of Cleveland operators descended on the Cincinnati office, with intent to found a local branch of the telegraphers' union. From time immemorial it has been customary to stimulate the flames of brotherly unity by copious alcoholic libations, and the Christian world has progressed little since the days when the Roman calendar was based "upon the foreign priest and the foreign cook." Edison's fraternal feelings were sufficiently genuine to be independent of this carnal basis, and being then what he is now, a scrupulously abstemious man, he discarded the company of the Bacchanalian revelers for the more congenial surroundings of the office. Not a soul was to be seen but the office boy. The Cleveland wire imperatively demanded "report," but none was forthcoming, until, at length, after an hour's irresolution, Edison supplied the gap, manipulating the wire with his usual practiced skill. At eight the next morning he was in his accustomed place, despite the severe and protracted labors of the night.

Edison endeavored to suppress the irregularities of his friends, together with the record of his timely exertions in their behalf—a secrecy which speaks volumes for his sense of honor and kindliness of heart—but the office boy divulged the facts, securing to the young operator not only the lasting favor of his employers, but an increased salary of $105. The Louisville

wire, an important section, carrying all the Southern reports and necessitating expert skill, was placed in his hands, and Edison sustained a brisk competition with the Louisville operator, Mr. Robert Martin, a gentleman renowned for rapidity and clearness of transmission. To this advantageous partnership he attributes the final fruition of his abilities.

Memphis, Tennessee, was his next move. Here the operators received $125 a month and rations, counterbalanced by the fact that they were under the most stringent military law. Edison's abilities either won respect or excited a rancorous envy, according to the class of individual with whom he had to deal, and in the present instance he was unfortunately thrown in with a manager incapable of generous appreciation and jealous of rising talent. This liberal-minded gentleman was endeavoring to perfect a repeater of his own invention at the time of Edison's arrival, but his efforts had been hitherto fruitless. Edison, with characteristic energy, commenced experiments at once, which were crowned with success, and in consequence of which Louisville and New Orleans were connected for the first time in the annals of telegraphy. This turn of events so enraged the manager that he brought a fictitious charge against his rival, which resulted in the latter's dismissal.

This was a serious misfortune, and befell our hero at a time when he was ill prepared to be thrown on his own resources. Such portions of his salary as had not found their way home, had long ago been transmuted into books and instruments, and his wardrobe was in the last stages of destitution. His health, too, was beginning to feel the strain of his sleepless nights and protracted labors, and altogether he was a better subject for motherly coddling than for the rude experience which lay before him. But the indomitable spirit within refused to yield to the forces arrayed against it, and this seventeen-year-old lad, feeble, penniless and sore-hearted, actually conceived and

carried out the plan of reaching the city of Louisville, walking one hundred miles, and obtaining free transportation for the remainder of the distance.

At Nashville he was joined by a fellow operator, one William Foley, a lad of shady reputation but good heart, and together the two boys pursued their journey, arriving at their destination one bleak and cheerless morning, toward the beginning of winter. The church bells were clanging the hour of six, and the great city, with its ice-locked streets, seemed the external projection of the colder hearts within its gates. Nothing more desolate can be conceived than the figure of this slender, eager-eyed lad, stranded on the margin of this desert, faint with hunger and fatigue, paralyzed with cold, and disheartened with injustice and rough usage. The support, accruing from costly attire, was lacking, and Edison was now sufficiently a citizen of the world to know that his unprepossessing exterior far outweighed any mental or moral qualifications. "Is it not to clothes that most men do reverence—to the fine, befrogged broadcloth?" Soleless shoes clung fragmentarily to his aching feet, a straw hat covered his head, thin summer underwear mocked the searching blasts, and a miserable linen duster threw its poor protection over the stained and threadbare raiment. That vacuum, which nature so cordially abhors, was visible in his pockets, and a handkerchief, suspended over his shoulders, carried the bulk of his worldly gear. In this humble fashion he presented himself at the telegraph office, where he was distrustfully and superciliously received. Gradually, however, the tests of skill which he submitted to the manager, backed by his bright and earnest manner, won their way to public approval, and he was installed as operator, a position which he retained for two years, despite the most uncongenial surroundings. The employees were vulgar, unprincipled and overbearing, and disposed to ridicule their rustic associate. In course of

PHOTO BY W. K. L. DICKSON.

PORTRAIT OF EDISON IN 1893.

time, however, Edison's kindness of disposition, his innocent and studious life, and his phenomenal abilities disarmed their prejudices and commanded their respect.

Edison's mind was upset about this time by certain tantalizing reports relative to the marvelous resources of Southern America, and, in conjunction with two of his friends, Messrs. Keen and Warren, he started on his quest. His mental balance was fortunately restored upon his arrival at New Orleans, where he met an ancient and traveled Spaniard who persuaded him to return to his native clime, averring that for government, institutions, climate and people the United States were unsurpassed by any country on the face of the earth. A brief but pleasant visit to his relatives in Port Huron followed, after which Edison resumed his work at the Louisville telegraph office. True to his dominant instincts, he was not long in gathering around him a laboratory, printing office and machine shop. He took press reports during his whole stay, including on one occasion the Presidential message and veto of the District of Columbia Bill by Andrew Johnson. This at one sitting, from 3.30 P. M. to 4.30 A. M. He then paragraphed the matter received over the wires, so that each printer had exactly three lines, thus enabling a column to be set up in two or three minutes' time. For this he was allowed all the exchanges he desired, and the Louisville press gave him a state dinner.

"I began," said Mr. Edison, "to frequent second-hand book stores and acquired quite a library. There was to be a contest for fast sending amongst the telegraphers. I was comparatively poor at sending, but a first-class receiver. I therefore rigged up an automatic machine whereby I could record the matter very slowly and perfectly, and then reproduce it at any increased speed. Unfortunately the tournament did not come off, or I should have been the winner. The Louisville office was during and at the end of the war in a very dilapidated

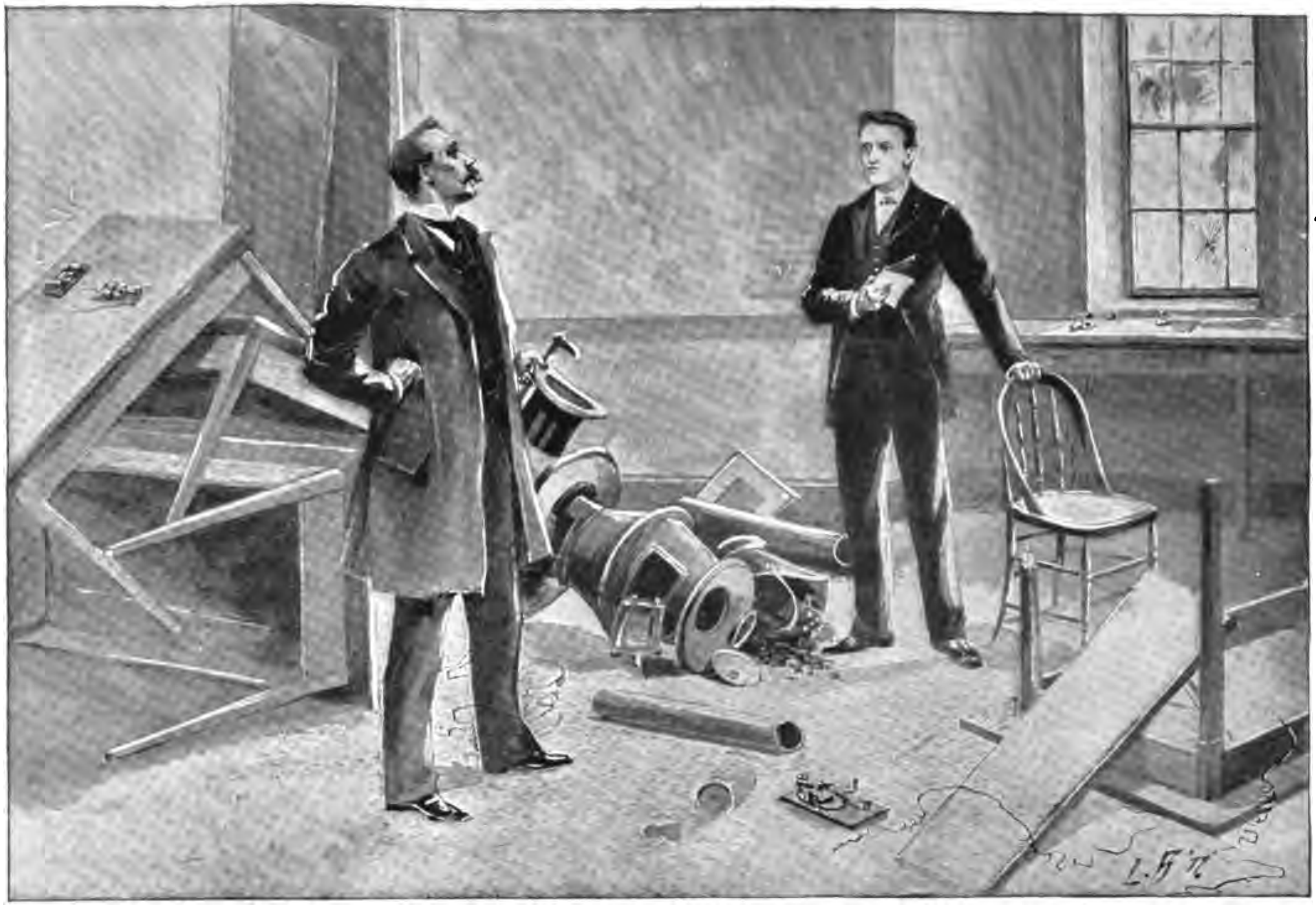
condition, and the management was correspondingly lax. One night when I was taking reports I heard a tremendous noise on the stairs, and there appeared at the door one of the most skilled operators in the force, a man whose splendid abilities were crippled by his habitual drunkenness. He was now in one of his most violent fits. He hesitated an instant, then walked in, kicked over the stove with its long length of sooty stovepipe, then proceeded to pull down the switch-board and yank all the operating tables away from the side of the wall, piling their instruments and all on the top of each other. Then he proceeded to the battery room, where he pulled down the shelves with their contents, upsetting a bottle of nitric acid, which ran through the ceiling to the office below, eating up the books it traveled over. He then disappeared. I tested and found out his wire, rigged up a temporary table and furnished the report, stopping at the office until the arrival of the manager. The latter came at eight o'clock, and on entering the office was dumfounded.

"'Who did this?' he inquired.

"'Billy L.,' I replied, unwillingly.

"The manager walked the floor for a minute, then said, 'If Billy ever does this again I'll discharge him.'

"It was the habit of the night boys to go off on a *jamboree* quite frequently. Not being a drinking man, I was generally induced to act as treasurer and dole the money out in such quantities as to secure comparative sobriety at work time. A new man joined the force and gave up his money with the rest. When sober he was very mild-mannered, but on one of these excursions I didn't gauge his capacity for alcohol exactly right. He demanded more money, which I refused, whereupon he knocked the treasurer down, and was proceeding to break me all up when he was pulled away by the others, and given such a mauling that he was three weeks in the hospital."



"IF BILLY EVER DOES THIS AGAIN, I'LL DISCHARGE HIM."

To Edison's kindly sympathies was largely due the chronic impecuniosity in which he was plunged. Having no dissipated tastes of his own to indulge in, and dwelling in a region remote from the exactions of fashion, his spare cash, outside of scientific claims, was always at the disposal of any brother in distress or disgrace. This fact was speedily ascertained by his associates and utilized in the most barefaced manner.

The Louisville operators were experts in their line, but the demoralization produced by the war had resulted in a nomadic system which played havoc with morals and discipline. They were known as "tramp operators," and picked up a precarious living, wandering from city to city, terminating each engagement, as a rule, by a gigantic spree. It was this class which principally sponged upon Edison.

On one occasion our hero invested in fifty volumes of the North American Review at an auction, carried them home in triumph, and disposed them tastefully about the walls of his room, which at this time was affording refuge to half-a-dozen scientific Arabs. These gentlemen, after watching the operations of their host, concluded that the new consignment would subserve their interests better by being transplanted to another sphere, and availed themselves of Edison's absence to purloin the whole set of ponderous volumes, carrying them to a pawnshop, where the equivalent they received formed the basis of copious potations. On another occasion Edison returned after a night of hard work at the unearthly hour of 3.30 A. M., to find his room reduced to the semblance of the ruins of Carthage, and two of his guests in bed with their boots on.

"I felt," remarks Mr. Edison, with humorous despair, "that this was running hospitality to the ground, so I pulled them out, and left them on the floor to cool off from their alcoholic trance."

Edison's nocturnal expeditions were the means of exciting suspicion amongst the guardians of public safety, and nearly resulted in serious consequences.

"I was once returning," he says, "from an auction, at 3.30 A. M., with a load of books on my shoulder, when a policeman halloed me to stop, following up his injunctions with a pistolshot when I failed to comply. He had taken me for a thief, retreating from some burglarious enterprise, and his suspicion had been strengthened when I, being unable to hear, made no answer to his first challenge. My identity was known to him, however, and he released me instantly on a closer inspection."

It may not be generally known that Edison's deafness was contracted by the brutality of the Grand Trunk conductor who, in ejecting the lad from the car, boxed his ears with such violence as to injure indelibly the delicate auditory nerves and membranes. The disease has never yielded to surgical treatment, although the finest skill has been employed, but the great inventor accepts the infirmity with the sunny philosophy which is one of his distinguishing characteristics, and pursues his labors without a tinge of that self-pity which affords to lesser minds such depths of consolation.

Here Edison issued his first electrical treatise, and here was evolved the style of penmanship, a specimen of which is given on page 41. Legible and symmetrical as it is, he was able to produce it at the rate of forty-five words a minute, a speed commensurate with the extreme limit of a Morse operator's powers of transmission.

The old office was abandoned in course of time for a spacious building, richly furnished and supplied with excellent mechanical appliances. With the improved facilities of the company, however, came a stricter code of discipline, of which Edison was unfortunately the first victim. The instruments were now riveted firmly in place, and the operators were for-

bidden under severe penalties to remove them. A similar embargo was laid upon the chemicals, both of which wholesome regulations were disregarded. Each instrument was cautiously abstracted and utilized as a basis for experimenting, and the chemicals shared the same fate. "I went one night," says Edison, "into the battery room to obtain some sulphuric acid for experimenting. The acid in the carboy tipped over, ate up the floor, and went through to the manager's room below, ate up *his* desk and all the carpet. The next morning I was summoned before the board and told that what they wanted was telegraph operators, not experimenters, so that I was at liberty to take my pay and leave."

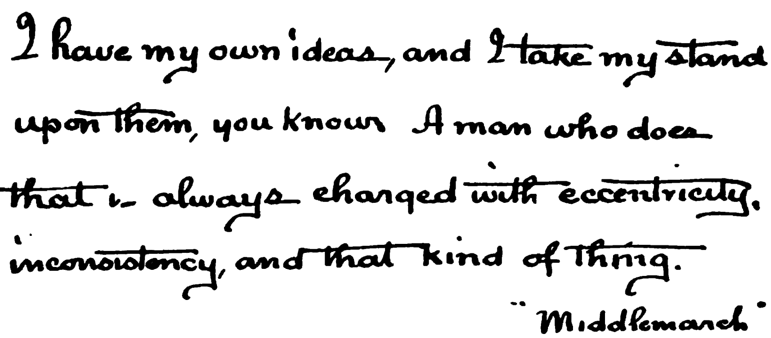
From this home of outraged virtue, Edison betook himself to Cincinnati in the capacity of telegraph operator. The vicinity of the machine shed, attached to the railroad depot, was too tempting to be overlooked, and enlisted much of the young man's time, ending in an elopement with one of the main engines, during the temporary somnolence of engineer and fireman. The trip was successfully accomplished, and the engine duly returned to its shed, but the inexperience of its amateur guide had left traces of guilt in copious streams of dirty water, and encrustations of soot, resulting from the overfilling of the boiler and its discharge upon the smokestack. Despite this trifling casualty, however, the machine shed yielded much valuable knowledge, and served as the hotbed for those germs of scientific thought of which duplex telegraphy and electrical railroading were the perfected results. From there he went to Port Huron for a period of eighteen months, which brought him to the twenty-first year of his age. His work was of a character similar to that which, at Louisville, had been so ruthlessly sacrificed on the altar of experimental science, and the commonplace grind of his duties was again enlivened by stolen trips to the local Library, together with the prosecution of pet

inventive schemes. One of the latter was an ingenious device by which a single submarine cable could be utilized for two circuits, and by which a saving of $5000 was effected. This was adopted by the Grand Trunk Railway Company, who presented the young inventor with a free pass to Boston, where a position awaited him in the Franklin telegraphic office, secured by the friendly offices of his life-long friend, Mr. Milton Adams.

Edison was, as usual, in deep financial waters. His insatiable cravings for scientific appliances, together with a pressure of home claims and outside charities, left little or no surplus for the toilet, and the adornment of his person always took a subordinate place in his calculations.

"I had been four days and nights on the road," said Mr. Edison, "and, having had very little sleep, did not present a very fresh or stylish appearance, especially as compared to the operators of the East, who were far more dressy than their brethren of the West. The manager asked me when I was ready to go to work. 'Now,' I replied. I was then told to return at 5.50 P. M., and punctually at that hour I entered the main operating rooms, and was introduced to the night manager. My peculiar appearance caused much mirth, and, as I afterwards learnt, the night operators consulted together how they might 'put a job on the jay from the woolly West.' I was given a pen and assigned the New York No. 1 wire. After waiting upwards of one hour I was told to come over to a special table, and take a special report for the *Boston Herald*, the conspirators having arranged to have one of the fastest senders in New York to send the dispatch and 'salt' the new man. I sat down unsuspiciously at the table and the New York man started slowly. I had long since perfected myself in a simple and rapid style of handwriting, devoid of flourishes, and susceptible of being increased from forty-five to fifty-four words a minute by gradually reducing the size of the lettering. This

was several words faster than any operator in the United States. Soon the New York operator increased his speed, to which I easily adapted my pace. This put my rival on his mettle, and he put on his best powers, which, however, were soon reached. At this point I happened to look up, and saw the operators all looking over my shoulder, with their faces shining with fun and excitement. I knew then that they were trying to put a job on me, but kept my own counsel and went on placidly with my work, even sharpening a pencil at intervals, by way of extra aggravation. The New York man then commenced to slur over


I have my own ideas, and I take my stand upon them, you know. A man who does that is always charged with eccentricity, inconsistency, and that kind of thing.
"Middlemarch."

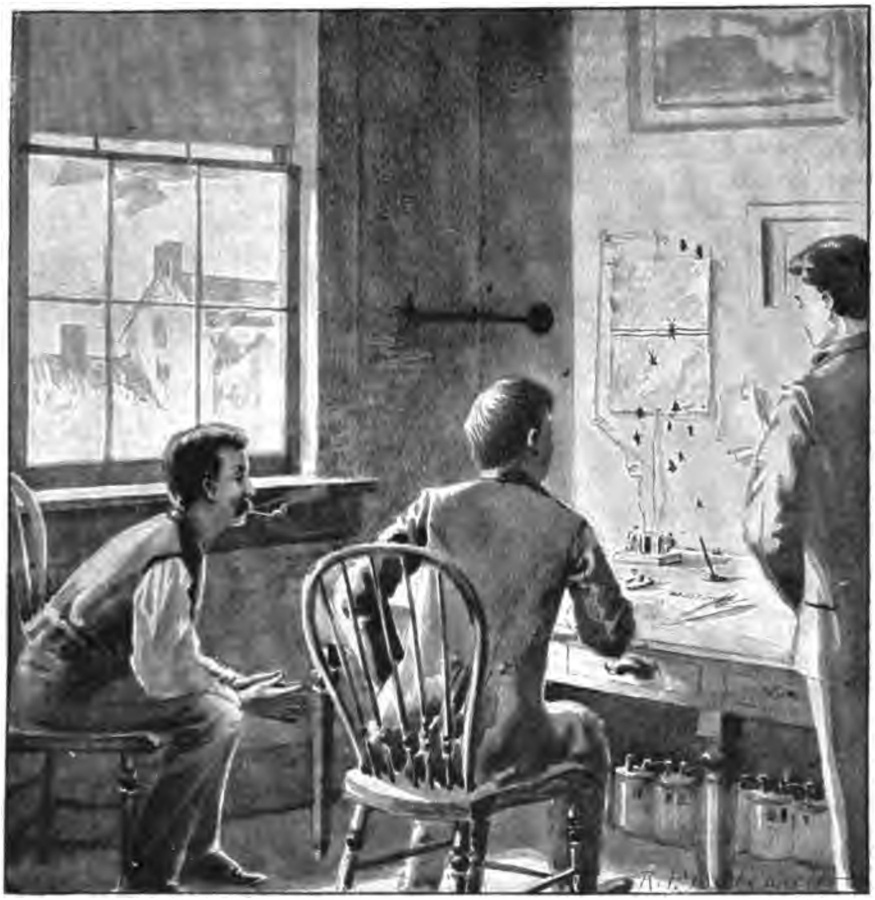
A SPECIMEN OF EDISON'S HANDWRITING.

his words, running them together, and sticking the signals; but I had been used to this style of telegraphy in taking report and was not in the least discomfited. Finally, when I thought the fun had gone far enough, and having about completed the special, I quietly opened the key and remarked, 'Say, young man, change off, and send with your other foot.' This broke the New York man all up, and he turned the job over to another man to finish."

This dazzling feat was the means of permanently securing the respect of Edison's associates, and "the jay from the woolly West" took his place at once and for ever as a prominent and

esteemed member of the community. Here also the desolate and friendless boy was cheered by the intelligent sympathy of Mr. Adams and Mr. G. F. Millikin, the manager, the first men possessed of sufficient intuition to gauge the splendid qualities underlying that uncouth exterior.

Vitalized by the sunny influences around him, sustained by a sense of recognized and inherent power, and, through a happy turn in home affairs, relieved from the cruel pressure of want, Edison's latent humor came into play, and found expression in many harmless pleasantries, notably the wholesale destruction of certain huge and aggressive cockroaches, which devastated the premises. Sanguinary hostilities had long been on foot between the operators and the insects, with decided advantage on the latter side. Once in a while some gifted human strategist would consign a battalion of the enemy to a watery grave, or, heading a frantic war-dance of his peers, reduce a couple of regiments to a mere spreading of animal matter; but these engagements were rarely crowned with success, and did not tend materially to depopulate the inimical forces. The feud was now a hereditary one, like the Punic wars of old; quickened with the gore of patriotic insects, and stimulated into abiding vigor by the successive odes of horned and antennaed bards. Marshaled by keen and doughty veterans, and hourly reinforced by new-born valor, the enemy was perceptibly increasing in numbers, strength and ferocity, whilst the courage and skill of the besieged were waning in equal ratio. No hiding-places, however cunningly constructed, could hold their foraging parties at bay; no shelf, hook or nail their scaling forces. Over books, papers, instruments, provisions and garments, lay the shining track of the foe, like the trail of the serpent on the emerald bowers of Eden. It was at this critical juncture that our youthful knight made his appearance. Single-handed and, like "Ithuriel of the fiery spear," armed



EDISON'S METHOD OF KILLING COCKROACHES.

only with the luminous lance of electricity, he vaulted into the lists, war and conflagration in his path, and this was the manner of that memorable fray, told in the prosaic terms of the nineteenth century.

"Curiosity betrayed our Mother Eve," if we may credit an exalted, though ungallant source, and curiosity lured those invincible insects to their doom. Death in the thin masquerade of water-traps, bootheels and "Rough on Roaches," had long been sufficiently familiar to inspire contempt, but the king of terrors

in Edisonian garb was an unknown factor in their calculations. Our ingenious trickster proceeded to secure certain alluring strips of shining tinfoil against the office walls, baited with such edibles as appeal most strongly to the gastronomic instincts of the cockroach, connected the strips with a powerful battery, and was rewarded by the spectacle of a steady rain of calcined insects pouring from the improvised crematory overhead.

CHAPTER III.

LIFE IN BOSTON. THE VOTE RECORDER. EDISON'S FIRST PATENTED INVENTION. TELEGRAPHY. THE DUPLEX AND QUADRUPLEX SYSTEMS. ARRIVAL IN NEW YORK. A PANIC IN THE GOLD MARKET. EDISON TO THE RESCUE. INVENTION OF GOLD AND REPORTING PRINTER.

BY one of Fortune's vagaries, Mr. Milton Adams, through whose kindly exertions Edison's situation was procured, himself fell out of employment and was at his former protegè's charges for lodging and entertainment, both of which were gladly tendered. Edison's hospitable instincts were based upon Victor Hugo's immortal words:

> "Gratitude is a heavy burden; when thou wouldst impose it upon any one, do it only with all the delicacy of which thy soul is capable, so as not to wound him."

We may be certain that Mr. Adams' reverses of fortune and his temporary dependence were made as pleasant to him as circumstances would permit, and that a Mark Tapley humor was born of impecuniosity.

To gentlemen of Bohemian tastes and light pockets, the "Hub" offers many inexpensive dissipations, and of these none commended themselves so entirely to the inclinations of the two friends as lengthened strolls among the second-hand book shops and general junk stores which stud the ungenteel portions of Boston. Here an amusing incident occurred, which we will give in Mr. Edison's own words.

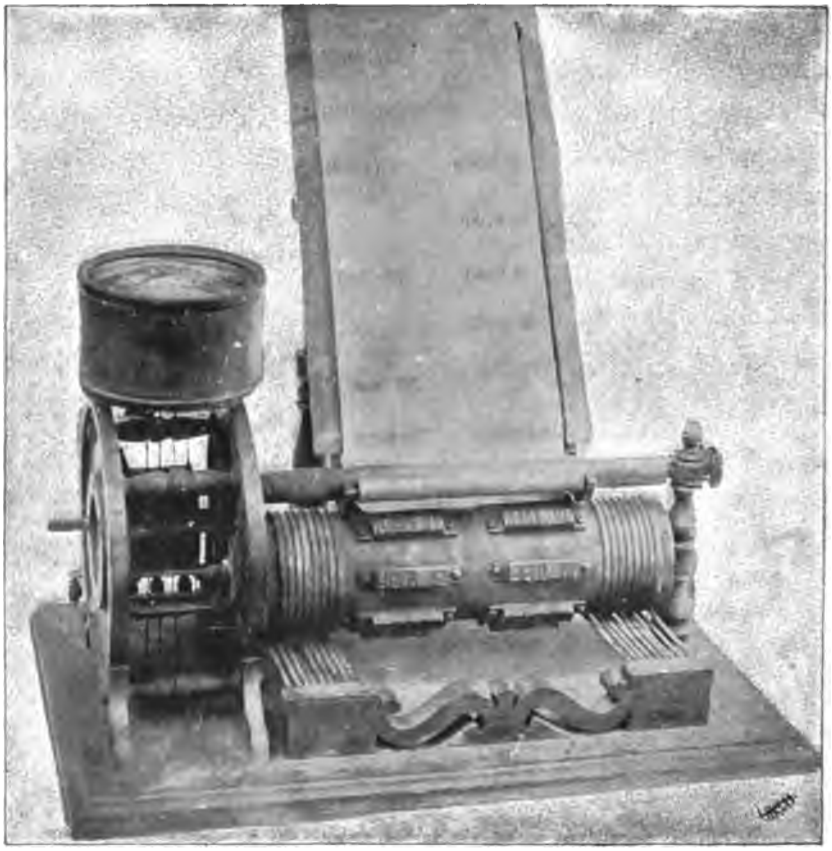
"One day, Milton and I were passing along Tremont Row, when we noticed a crowd collected in front of two dry goods stores and stopped to see what was the matter. It happened that these were rival establishments, and that each had received a consignment of stockings which they were eager to dispose of. Their methods were very entertaining. One would put out a sign stating that this vast commercial emporium had five thousand pairs of stockings to dispose of at the paralyzing price of twelve cents a pair, an announcement which invariably wound up with 'no connection with the firm next door.' In a moment the rival firm would follow suit, underbidding the other by one cent at a time, until the price was reduced to one cent for five pairs of stockings. The crowd had been steadily increasing all the time, contenting itself with jeering and making merry, but showing no avidity to avail themselves of these tempting bargains. Milton and I had been agog, however, for some time, and he now broke out: 'Say, Edison, I can stand this no longer, give me a cent,' and being supplied with this handsome financial basis, boldly entered the store, which was filled with lady clerks. Throwing down the cent, he demanded five pairs of stockings, while the crowd excitedly awaited the result. The young lady attendant surveyed the customer with magnificent disdain, and handed him five pairs of baby stockings. 'Oh!' said my friend, in much discomfiture, 'I can't use these.'

"'Can't help it, young man,' was the curt reply; 'we don't permit selections at that price.'"

The crowd roared, and the commercial struggle ended. All of Edison's investigations were not as fruitless as the above. The queer old shops hidden away in the dusky and gabled streets, yielded up many of those scientific appurtenances without which Edison's life would have been an arid desert. Gradually the workshop, laboratory and library took shape about him and the great city assumed the elements of home. Boston had

many features suited to the varied mentality of the young scientist. The northern portion of the city, with its quaint architecture and circuitous streets, recalled the historic events of past centuries, and imbued with fresh vitality many a half forgotten legend of his childhood, while Boston of the present, with its converging nationalities, its teeming enterprise, and its exceptional culture, was eminently attractive to his alert and vigorous mind, poised as that mind was upon the pivotal point of receptivity. But dearer than past or present was the future of his country, and the genius of scientific progress exercised paramount sway, inciting to fresh research and ripened effort. The superb resources of the Boston Public Library—a unique

EDISON LOWERED THE NITRO-GLYCERINE INTO THE SEWER.



VOTE RECORDER—FIRST INVENTION PATENTED BY EDISON.

collection of some two hundred and eighty thousand volumes—were at his disposal, bringing him into contact with the master minds of the age, and stimulating into being his dawning inventive powers.

No jealous detraction awaited him at the hand of his employers, and the shallow prejudices of his associates had long since been overcome. The way, therefore, to successful research lay clearly mapped out before him and was unflinchingly pursued.

"He was soon deeply immersed in experimenting," says Mr. Adams, "despite the fact that our rooms in Harrison avenue were a mile distant from the place in Hanover street where we

took our meals. He bought, one day, the whole of Faraday's works on electricity, brought them home at three o'clock in the morning and read assiduously until I rose, when we made for Hanover street to secure breakfast. Tom's brain was on fire with what he had read, and he suddenly remarked to me:

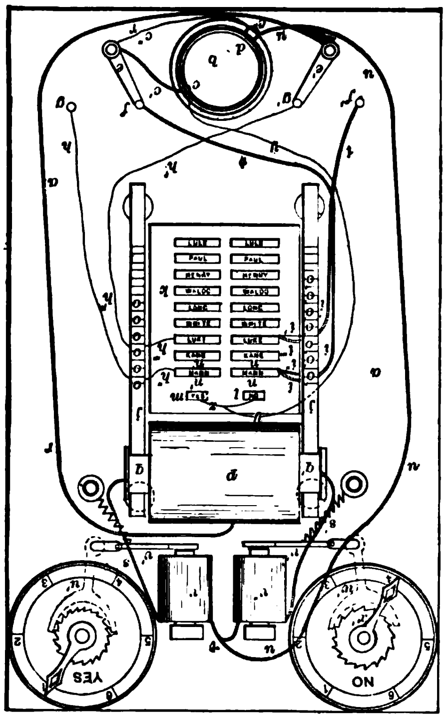


DIAGRAM OF VOTE RECORDER.

"'Adams, I've got so much to do, and life is so short, that I am going to hustle.' And with that he started on a dead run for his breakfast."

During his night work Edison became acquainted with one of the mechanics in the telegraphic instrument factory of Charles Williams, Jr. This workman was "addicted" to experimenting, and joined Edison in many of his exploits, one of which was very nearly the means of bringing the scientists to an untimely end.

"I had read," says Mr. Edison, "in a scientific paper the method of making nitro-glycerine, and was so fired by the wonderful properties it was said to possess, that I determined, with the help of the above individual, to make some of the compound. We tested what we considered a very small quantity, but this produced such terrific and unexpected results that we became alarmed, the fact dawning upon us that we had a very large white elephant in our possession. At 6 A. M. I put the explosive into a sarsaparilla bottle, tied a string to it, wrapped it in a paper and

gently let it down into the sewer, corner of State and Washington streets."

Shortly after Edison's arrival in Boston he commenced experiments upon a vote recorder, exclusive rights for which were obtained in 1869. This was Mr. Edison's first patent, and might be simply described as an electrical apparatus for recording votes. By turning one of the switches placed at each voter's desk, either to the right or to the left, the current from a battery flows first through a magnet, actuating an armature, impelling forward a ratchet wheel, to which a pointer is attached, and so registering one vote, affirmative or negative, as the case may be. The same current simultaneously releases a clockwork movement which turns two metal rollers, the upper smooth and working on an eccentric, by a rising and falling movement, the lower embossed with a double set of types (as shown), between which a sheet of chemical paper is carried, the current passing to the upper roller through the paper to the raised type. This completes the circuit, leaving a brown impression or stain. The printed record passes up and down in full view, exhibiting the votes for and against the several candidates or bill under consideration.

The fruition of this ingenious device had been a labor of love with the young inventor, who spared neither time nor money to secure its introduction. Through the zealous efforts of Edison's friends the matter was brought before the Massachusetts Legislature, but unsuccessfully, and for a reason which furnishes a significant comment upon our political methods.

"No use, Edison," reported that gentleman's plenipotentiary on his return, "the thing is a dead failure."

"Impossible," replied the young inventor aghast, "I know it will work."

"Yes," answered his friend, "for that very reason it is a failure. I talked with some of the members and they explained

to me how the great power of the House lies in their being able to employ obstructive tactics, called in parliamentary language *filibustering*, and indulged in for the purpose of preventing partisan legislation. This invention of yours would take away that power, and they would not have it in the House if you paid them to use it."

"Ever after," says Mr. Edison, "I investigated minutely the necessity of any particular invention, before I attempted its reduction to practice. To this decision I have made it the rule of my life to adhere."

After completing the vote recorder, Edison's next move was the enlargement of a small workshop used habitually by him for his private experimenting. There he labored during the hours of daylight, building mechanical appliances, and erecting lines for different firms, utilizing dial instruments of his own manufacture. This in connection with his regular night work at the Western Union Telegraph Company. During this time he conceived and partially matured a stock quotation printer, for printing the price of stocks in various brokers' offices, erected several lines and put in a number of instruments; but meeting with inadequate encouragement on this score, he abandoned the scheme for the nonce and applied himself to the development of duplex telegraphy. It will be seen later, in the episode relating to Edison's arrival at the headquarters of the Laws' Gold Reporting office, how excellent and opportune was the information garnered during this seemingly fruitless epoch.

Edison's scientific position in Boston was now firmly established, and his moral status so unimpeachable that he was selected by a fashionable female academy to lecture on telegraphy. Immersed in other projects, he not only neglected to inquire into the sex of his audience, but totally overlooked the appointment, and when summoned by his friend, Mr. Adams, was discovered on the top of a house performing certain acrobatic

feats connected with the erection of a telegraph wire. Curiously enough, Adams shared his colleague's ignorance in regard to the expected ordeal and, possessed like Edison with the belief that the audience would be composed of boys, thought it unnecessary, in view of the advanced hour, to devote any time to personal adornment. Unsuspiciously they hurried through the streets and plunged into the scientific arena, where to their horror and amazement they found themselves confronted, not by a horde of undisciplined boys, but by an assembly of elegantly attired young ladies. Confusion descended on them, their tongues clove to the roofs of their mouths, and the upturned sea of quizzical faces before them loomed faintly through a crimson haze. At last, Edison, possessed by the courage of despair, and seeing that Adams was absolutely *hors de combat*, plunged into the exposition of his subject and succeeded, in spite of certain catching sensations at the back of the throat, in conveying to the fair scientists a brief, pleasant and lucid view of the subject.

EDISON'S EARLY STOCK PRINTER.

To the credit of incipient womanhood be it chronicled, that this diffidence served Edison's cause better than a bumptious and self-satisfied glibness would have done.

> "In the modesty of fearful duty
> "They read as much as from the rattling tongue of saucy and audacious eloquence."

From that day the sweet girl graduates made a point of recognizing Edison in public, and bestowing upon him such nods, becks and wreathed smiles as made him a subject for envious admiration among his less favored associates.

Telegraphy had always been a favorite branch of electrical science with Edison, and he now plunged into his experimental

THE EDISON UNIVERSAL STOCK PRINTER.

study with an ardor no whit diminished since the days when his first schoolboy feats were achieved. In this connection, Mr. S. J. House once remarked to a newspaper reporter: "I see that Thomas Edison is now rated at $3,000,000. I knew Tom when he was a barefoot boy living at Fort Gratiot, Mich. He was always tinkering with telegraphy, and once rigged up a line from his home to mine, a block away. I could not receive

very well, and sometimes I would come out, climb on the fence and halloa over to know what he said. That always angered him; he seemed to take it as a reflection upon his telegraph line."

Telegraphy had made very little perceptible progress during the period of Edison's investigations. It was in 1832 that Prof. Morse conceived the idea of an electric telegraph, the practical exposition of which was afforded in 1837, when he constructed his first working apparatus, consisting of a small wooden base, on which an electro-magnet was mounted, over which an armature or piece of soft iron was pivotally swung. At one end of the armature a steel point projected, under which a sheet of paper, attached to a grooved cylinder, was made to revolve, by clock work, at uniform speed.

The electro-magnet, made as now—of a core of soft iron, surrounded by many turns of insulated wire—when put into action by the distant closing of a key, caused the armature to be attracted as long as the current was allowed to flow through the magnet, the key being meanwhile held down. The result was a series of long or short dashes—impressions made at the will of the operator upon a traveling roll of paper. A pen was substituted later by Prof. Morse in place of the steel pointer, together with a long strip of paper for the inscription of the dots and dashes. Excellent and indispensable as was the basis afforded by the Morse system, it still presented certain imperfections and limitations, and to the removal of these Edison applied himself. His more matured experiments, commencing in 1869 and extending over a period of some six years, were crowned by a system of telegraphy, combining in such an eminent degree the attributes of inexpensiveness, ease of manipulation and increased speed, that to this day, despite furious litigation and envious detraction, it holds its own above all competitors. The forms of telegraphy which were eventually

evolved from this source are too numerous to mention, and the underlying details too complicated for full explanation in a work of the present kind, but a brief survey of the field may be admissible.

Among the more prominent forms are the duplex and quadruplex, by which two and four messages are susceptible of simultaneous transmission over a single wire. The latter, which is universally held to be Edison's crowning product in telegraphy, has effected in America alone the enormous saving of $15,000,000 by the use of this single wire for the two and four wires hitherto employed.

Nor does Mr. Edison propose to rest upon these results. He has been, and still is, engaged in experiments which bid fair to extend the quadruplex system into a sextuplex or even an octuplex, admitting of the passage of six and eight simultaneous messages over the same wire. This is tantamount to the facilities afforded by 70,000 miles of wire, in addition to those already in use by the Western Union Telegraph Company.

Two of the main features of the quadruplex system are probably based on the discovery of the polarized or neutral relay, and the earlier discovery, in 1872, that simultaneous transmission in opposite directions over a long line may be made feasible by the use of a condenser.

In order to understand in a measure how more than one message can be sent over a single wire, it must be clearly borne in mind that two methods are adopted for the transmission of these messages, which are totally different from each other. One method is commonly known as the *double current system*, and the other as the *single current* or *open circuit system.*

The double current system simply means that both negative and positive impulses are sent over the line to a distant relay without breaking the circuit at the key, which is provided with a double spring contact, and does not release the positive

contact before making connection with the negative one. Thus the current on the line is instantly reversed at the beginning and end of each upward and downward stroke of the key, the circuit being always closed.

The receiving relay has a permanently magnetized armature, and is free and without checking springs, being solely dependent for its action upon the reversals of current in the line, rather than on the strength of the latter.

In the open circuit or single current method, the relay is entirely dependent on the increase or decrease of a given current, which acts also on a polarized relay, having for an armature a permanent magnet, or even a core, composed of soft iron, controlled by a spring.

Strength of current in the one instance and polarity in the other are the distinguishing features of this method, and when these are used in connection with the duplex principle of dual messages, simultaneously transmitted over the same wire, the feasibility of quadrupling the number of these messages will be at once apprehended, and it will be unnecessary to explain the tangle of wires, magnets, condensers, quadruplex instruments, double and single transmitters, polarized relays, and to follow the various circuits, before the messages are allowed to escape upon the line.

Science no longer springs, full panoplied, from Titanic brains. Many hours of thought travail were needed to develop the immature ideas connected with the several branches of telegraphy, and their entrance into the scientific world was attended by distrust and detraction. In 1869, a year which witnessed the termination of Edison's Boston engagement, the duplex system was sufficiently matured to admit of a trial experiment, which was performed with the co-operation of Mr. F. L. Pope, patent adviser of the Western Union Telegraph Company. Imperfect as were the results, they yet presented to Edison's

prophetic mind the germs of future greatness, and inspired him with the desire of prosecuting his schemes in a wider field of action. A daring contemporary writer has observed, "Great is the Hub, but when a genius outgrows it, he goes to New York," and to New York our adventurer betook himself, after a flying trip to Rochester, undertaken for the purpose of testing the principles of his new invention by the wires of the Pacific and Atlantic Telegraph Company, but from the failure of the assistant at the New York end to understand the adjustments of so complicated an apparatus, the experiment was fruitless.

Not only was Edison's arrival in New York attended by his chronic condition of impecuniosity, but by a painful load of debt, amounting to some two or three hundred dollars.

Three weeks of picturesque nomadism followed, during which the lad suffered many things from hunger, rough quarters and discouraging interviews. One day, just at the time when courage and physical endurance were at their lowest ebb, he found himself on the steps of The Laws' Gold Reporting Company's office, Wall street. This establishment was the focussing point of no less than six hundred broker offices, to each of which it was connected by a system of indicators, and upon the successful working of these were based the pregnant issues of commercial activity. If the great heart of this gigantic system showed the faintest deviation from its accustomed rhythmic beat, it was the pleasing habit of these brokers to stimulate its action by the instantaneous despatch of a small boy, charged to the brim with excitement and indignation.

At the period of which we write, the Wall street world was convulsed to its centre, and every interest, social or political, was subordinated to the frenzied scrutiny of the financial field. Black Friday, that momentous struggle of September 24, 1869, instigated by Jay Gould and his peers, was already presaged in the frenzied excitement, the growing cunning and

HOW EDISON AVERTED A PANIC IN THE GOLD MARKET.

cupidity of the day. The brokers had been charged by the confederated schemers Jay Gould and James Fisk, Jr., to buy up all the gold within the bounds of New York city, with a view to creating a corner in the gold market. Steadily the price of gold rose, the speculators designing to carry it from 144 to 200 at least. The financial situation culminated on the twenty-fourth of September; the banks were rapidly selling, and gold was quoted at 162½ and upwards; many business houses were on the point of closing, from ignorance as to the prices charged for their goods. The terrible tension was brought to an end by the announcement that Secretary Boutwell of the United States Treasury had thrown $4,000,000 of the precious metal on the market!

Gold at once fell, and Messrs. Gould and Fisk retired from the field winners to the amount of many millions, but many

reputable firms were ruined. Events so black with portent could not but cast evil shadows before, and for many preceding days and weeks the air was heavy with prophetic gloom. Hearts had broken beneath the strain; lives were wrecked; fortunes vibrated on a pivotal centre more precarious than that of Karnac's sacrificial altars. Inflamed by the lust of gold, and reduced to the semblance of insatiate brutes, the great sea of sentient humanity surged around the shrine of its desires, screaming, cursing, gesticulating and fighting, filling the air with cruel shouts of triumph, or senile bursts of weeping—a scene inexpressibly base and humiliating, and which supplied no suggestion of that "measure of a man which is an angel." Alas!

> "How quickly Nature
> Falls to revolt when gold becomes her object."

At the supreme moment of this ignoble excitement, and while the eyes of thousands were riveted on the statistics supplied by the hundreds of indicators, the stock quotation printer, in the central office, suddenly collapsed, and with it expired every subordinate source of information.

Everything moves quickly in Wall street, and within the space of a minute the various avenues leading to the main office were thronged with the entire force of boyish emissaries—six hundred or more—each supplying his quota to the turmoil, and putting the finishing touches to the acute misery of the manager, who could not discover the cause of the trouble.

George Laws, of Laws' Gold Reporting Company, was a gentleman of keen susceptibilities and exuberant emotions, with a nervous system poised delicately on a hair trigger. His superintendent, Mr. Frank Pope, resembled his chief closely in these respects. and in sudden emergencies the two men acted and reacted upon each other in a manner calculated to neutral-

ize stagnation, but scarcely to promote the even tenor of commercial ways. This sudden and inexplicable calamity threw Messrs. Laws and Pope completely off their mental balance, and, to use a stage expression, they were adjuring the heavens, the nether regions and each other for assistance, waving the six hundred frantically aside, and exhibiting generally the features of advanced dementia.

It was at the moment that Edison, without any apparent reason, found himself among the crowd surging against the door.

Under cover of the pervading confusion, Edison had passed in unnoticed, subjected the apparatus to a swift but thorough scrutiny, and then quietly remarked: "I think, Mr. Laws, I can show you where the trouble lies. There is a contact spring which has broken and fallen between two cog-wheels, and prevents the gear from moving."

This proved to be the case. The obstruction was quickly removed, and the vital centre was again in touch with its dependent organs. Mr. Laws' emotions, now directed into pleasurable channels, overflowed upon this mysterious messenger of the great god Plutus, whose timely arrival had so revolutionized affairs, and Edison soon found himself the centre of admiration and the focusing point of hero-worship to the six hundred. A brief conversation ensued, a few unimportant inquiries were made, and the whilom vagabond, with his floating establishment, his frayed garments and his dirty shoes, soon found himself in the enviable position of confidential advisor to an influential firm, with the prospect of certain and remunerative employment. These negotiations were concluded on the following day, when Edison was requested to call again at Mr. Laws' office. At that interview he was asked many additional questions, the answer to which indicated such a thorough familiarity with the apparatus that Mr. Laws, foreseeing a respite from the vicissitudes which were threatening to undermine his constitution,

finally inquired whether Edison could take charge of the whole vast machinery and pledge himself to run it successfully. Edison quietly replied in the affirmative, whereupon Mr. Laws at once engaged him at a salary of three hundred dollars per month, very nearly three times as large as Edison had ever been in the habit of receiving as an operator.

Relieved from the pressure of financial embarrassment and stimulated by the confidence displayed by his new employer, Edison brought many of those ideas into requisition which his lack of means and influence had forced him to abandon. The gold indicator was placed in his charge and interwoven with important improvements, but this was eventually abandoned for a stock quotation printer of Edison's own devising, the workings of which were so satisfactory that Mr. Laws spared neither trouble nor expense in introducing it. The Edison stock printer was at that time intended principally for the gold market, and was designed to print letters, figures or characters from a double type wheel.

The current flowing through two electro-magnets, placed side by side in the receiving instrument, operated a type wheel, which, in its turn, after an almost imperceptible pause, in which the wheel is allowed to rest, passes on to the second magnet, which furnishes the impelling power to the printing mechanism.

The operation of these magnets is controlled by a clever arrangement of escapements and gears, the sending and receiving instruments working exactly together, so that the band of paper is brought up suddenly against the type wheel by a wave of passing electricity. Each electrical impulse carries the paper on one step, and the rotating wheel being brought into contact with a felt roller, saturated with printers' ink, the desired impressions are produced.

The success of the new instrument so alarmed competitors that a consolidation took place and Edison lost his position.

He was, however, soon offered one by the consolidated company, which he refused, preferring to enter into a copartnership with a firm of electricians. While connected with this firm he invented an improved form of the gold and reporting printer, and a prosperous exchange was established, which was ultimately bought up by the consolidated company.

CHAPTER IV.

PUBLIC RECOGNITION OF EDISON. NEGOTIATIONS WITH LEADING TELEGRAPHIC COMPANIES. INAUGURATION OF NEWARK FACTORY. PECULIAR MANAGEMENT OF ESTABLISHMENT.

THAT

> "Tide in the affairs of men
> Which, taken at the flood, leads on to fortune,
> Omitted all the voyage of their life
> Is bound in shallows and in miseries,"

had set in for Edison's storm-tossed craft, and a steady gale blew from the Blessed Isles, wafting the adventurer into all tempting harbors of successful discovery.

"Enterprises of great pith and moment" filled Edison's restless brain and gave employment to his tireless energies, but the financial basis was not as liberal as in the days of Mr. Laws' personal management, and, as the inventor humorously remarked: "I got tired doing all the work of the firm with a compensation narrowed down to the point of extinguishment by the superior business abilities of my partners." He therefore retired from the firm and connected himself with General Marshall Lefferts, then president of the Gold and Stock Telegraph Company. The facilities furnished by General Lefferts led Edison to the invention of a host of stock printers and private printing telegraphic appliances, which commended themselves so entirely to the com-

pany that they appointed a committee to wait upon Edison, with a view to securing the title of these inventions. Edison's dealings with that august body are best told in his own words. "I had made up my mind that five thousand dollars would be about right, although other people were paid exorbitant prices for very inferior inventions, but rather than not sell the inventions, I would take anything, no matter what, as I needed money sorely for my further experiments. With these dazzling expectations I received the committee.

"'Well, Mr. Edison,' said one of the members, 'how much do you want for your devices?'

"'I do not know what they are worth,' was my reply. 'Make me an offer.'

"'Well,' continued the speaker, 'How would forty thousand dollars strike you?'

"I believe I could have been knocked down with the traditional feather, so astonished was I at the sum. I immediately accepted, but after I got over my excitement, I concluded there must be some Wall street trick about this thing. I had been reading about Wall street tricks for years, and thinking this was one of them, I concluded that if I ever got a cent I would be lucky. However, I was anxious to see the process worked out, so two days afterwards, a large, formidable contract was given me to sign, couched in phraseology as obscure to me as Choctaw. I was told that I would receive the money upon signing this, which I promptly did, after which a check was given me on a bank on William and Wall street, to which goal I at once proceeded. I had never been in a bank before, so I hung around in order to see the methods of procedure, then took my place with a row of boys at the paying-teller's window. When my turn came and I presented the check, the paying teller yelled out a lot of jargon, which I failed to understand on account of my deafness. Again he roared something at me,

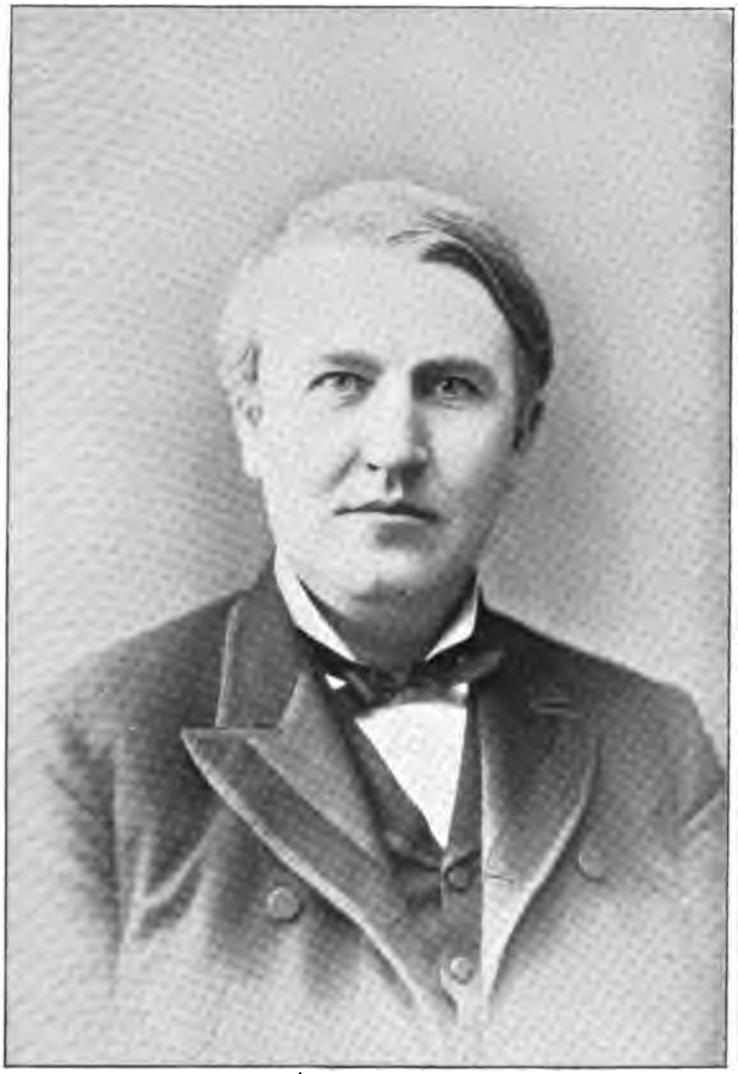


PHOTO BY W. K. L. DICKSON.

A RECENT PORTRAIT OF EDISON.

but I could not catch it, so left my place and passed on. Sitting dismally on the steps of the bank, I concluded that I was never fated to see that money, and so hopeless did I become that anyone might have bought that check from me for fifty dollars. However, I went back and told one of the clerks in the company's office about the bank episode, when he explained that the teller evidently wanted me to be identified. He then went back to the bank with me, performed the ceremony of identification, and the money was at once paid, greatly to my astonishment. In thirty days I had fully equipped a shop of my own, an investment which left me very little money."

Several of these minor shops were successively occupied by Mr. Edison, and, despite the paucity of space and the limited appliances, much valuable work was accomplished.

"From these establishments," continues Mr. Edison, "a large number of inventions were turned out, the majority relating to printing telegraphs, after which I became associated with a party of capitalists, who formed the Automatic Telegraph Company, owning the inventions of a Mr. Little, for which great claims were made, but which upon actual trial were found inoperative, leaving the company in a quandary. They had constructed a line between New York City and Washington, firstly for experimental purposes and secondly for real business, but the latter could not be carried out on account of the failure of Mr. Little's apparatus. I was called in at this juncture and solved the problem in such a manner as to open the line for business."

Edison was rapidly rising in the esteem of his employers. His services were retained by the Western Union Telegraph Company, the Gold Stock Company, and other influential firms, and in the year 1873 he entered into an agreement with the two former companies which pledged him to the development of all ideas relating to telegraphy. A handsome salary was paid

EDISON LABORATORY AND FACTORY IN NEWARK, 1873.

him, and he was under contract, at very high rates, to concede to the companies the exclusive option on all telegraphic inventions. These demands made it imperative for him to secure a wider field of action and a larger corps of subordinates.

The establishment selected was wholly unpretentious and devoid of architectural beauty, but it was centrally located in Ward street, Newark, supplied with a comparative abundance of facilities and manned by a force of three hundred, over which Edison and his partner, Mr. William Unger, exercised a unique jurisdiction.

The general arrangements of the new enterprise were, to say the least, peculiar.

"I kept only pay-roll accounts," says Mr. Edison, "no other kind; preserved the bills and generally gave notes in payment. The first intimation that a note was due was the protest, after which I had to hustle around and raise the money. This saved the humbuggery of bookkeeping, which I never understood, and the arrangement possessed besides the advantage of being cheaper, as the protest fees were only one dollar and fifty cents. Notwithstanding this extraordinary method of doing business, every one was willing to accept the notes, and my credit was excellent during the years I occupied Ward street factory."

Mr. Edison's intolerance of the "humbuggery of bookkeeping" probably arose in part from the fact that in the early stages of Ward street factory that majestic establishment boasted the services of a bookkeeper, the sensational statements of whom were calculated to keep the working force alternating between rapture and despair. This gifted individual, winding up the books at the end of the first twelve months, discovered, or thought he discovered, a handsome surplus of $7500, and presented himself before his chief with that pleasing information. Edison was naturally delighted at the outcome of their first year's enterprise, and by way of celebrating the event gave orders that the boys should have a "rousing jamboree" at his expense. Before the order could be carried into effect, however, he began to experience a certain sense of insecurity, based upon the knowledge of his late serious expenditure, in connection with the fitting up the factory and the prosecution of innumerable scientific projects. He therefore determined to look into the books himself, and, after a night of exhaustive study, possessed himself of the paralyzing fact that instead of a surplus of $7500, the accounts showed a deficit of fifteen thousand, some odd dollars. It is needless to say that the order for festivities was abruptly countermanded.

The hours of work were as erratic as the finances, and must have resulted in utter anarchy and confusion, but for the prevailing spirit of affectionate co-operation which existed. The sunny enthusiasm which had stood Edison in such excellent stead during the years of his servitude acted magically now upon his subordinates and promoted an atmosphere of cheery perseverance very different from the sluggish and enforced activity too often noticeable in other establishments. The master-mind was discernible in the most insignificant details; the master-hand was at the disposal of the humblest mechanic. By example, by precept, by judicious incentives and by general companionship Edison kept the public interest sustained, and received the willing co-operation of his employees. "We had no fixed hours," says Mr. Edison, "but the men, so far from objecting to the irregularity, often begged to be allowed to return and complete certain experiments upon which they knew my heart was especially set."

There were times when Edison's joyous nature completely bubbled over, and swept all before it in a tide of boyish hilarity. On one of these occasions he returned to the Newark factory, after a successful trip to New York, where he had been fortunate enough to dispose advantageously of a pet invention. Entering the workshop with a whoop, he fired his silk hat into an oil pan, and was preparing to send his coat after it, when some one laughingly pinned him down, and relieved him of his impedimenta. Whenever an experiment of unusual importance was on hand, and it was necessary to rush it through in a given length of time, Edison was wont to go through the laboratory, scattering largesse with liberal hand, and inciting the men to fresh endeavor by humorous bets as to their incapacity. This invariably put the men on their mettle and brought out their utmost speed and skill.

The engrossing nature of his occupations may be inferred from the following amusing episode:

"I had a number of schemes fermenting in my brain," says

Mr. Edison, "foremost among which was the quadruplex telegraph. This problem was of the most difficult and complicated kind, and I bent all my energies toward its solution. It required a peculiar effort of the mind, such as the imagining of eight different things moving simultaneously on a mental plane, without any external mechanism to demonstrate its efficiency." While engaged upon these complex themes Edison was notified, with legal abruptness, that unless he paid his taxes the next day (the last of a term of grace) he would be compelled to pay twelve and a-half per cent. extra.

In compliance with this stern demand he repaired to the city hall and took his place at the end of the line with about one hundred ahead of him. During the tedious delay which followed while awaiting his turn, Edison had been working on that brain-dividing problem, the quadruplex telegraph, and had become totally abstracted from the matter which brought him to the tax office. The last moments of grace were almost at an end when Edison found himself in front of the implacable Rhadamanthus in charge, who gruffly said, "Now, then, young man, look sharp. What is your name?" "I had lost my composure completely," remarks Mr. Edison, "and all recollection as to my name as well, for I stared at the official behind the counter in blank perplexity and answered, 'I—I don't know.' Jumping to the conclusion, I suppose, that he had an idiot to deal with, the tax collector waved me impatiently aside. Others poured into my place, the fatal hour struck, and I found myself saddled with an extra charge of twelve and a-half per cent."

CHAPTER V.

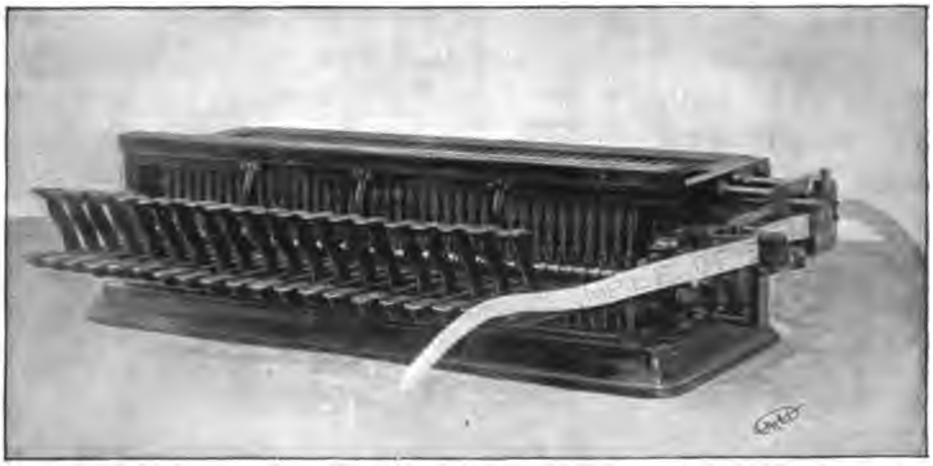
AUTOMATIC AND CHEMICAL TELEGRAPHY. STATISTICS OF SPEED. DISCOVERY AND APPLICATIONS OF ELECTRO-MOTOGRAPH AND CARBON BUTTON. THE CARBON TRANSMITTER.

COEVAL with the first development of the Quadruple and with the final completion of the Gold Stock Printer was the completion of Edison's Automatic Telegraph, a machine designed to render telegraphy wholly independent of human manipulation. Many important inventions of this class were in the field, notably those conceived by Alexander Bain, Sir Charles Wheatstone, Lefferts, Hummaston, Bradley, Craig, Little, and others, but the methods were comparatively cumbersome, and the speed insufficient. The inventors were baffled by a multitude of puzzling phenomena, and hampered by the difficulties attendant upon a swift preparation of the paper, and the control of the electrical currents. In 1870, as has been stated, Edison completed an apparatus by which the rapid preparation of the paper was achieved, and perfected auxiliary machinery for the transmission and reception of the messages. A year later, his efforts were rewarded by the discovery of the laws governing electrical waves, propelled at rapid speed over long distances, and applying the principle of inductive compensation to the waves, he secured to these subtle agents a velocity unequaled in scientific annals.

The Edison Automatic Telegraph System is comprised of three machines, one for perforating the paper strip in Morse

characters, one for transmitting the messages, and one for receiving them. The first machine, or perforator, Morse signs, is capable of punching out fifty or more words a minute. A long strip is run through the second machine, or transmitter, consisting of a drum, revolving at a uniform speed, and connected directly with the main telegraph line. The perforated strip is carried over the drum and the circuit is completed through metallic points, connected to the battery and the earth. The pens reaching through the perforations send a series of impulses over the line, making contact with the metal drum, and so registering at the other end upon chemical paper, and by means of electro-chemical decomposition, a series of short and long dashes of a dark blue color, exactly similar to the punched characters at the sending station. The receiving strip of chemical paper is placed upon a registering metal drum, the pointers of which are in readiness to transmit every impulse to the surface of the paper. The Automatic Telegraph is as simple as the Quadruplex is complicated, and its capacity may be indefinitely increased by the addition of extra perforators.

The Automatic Telegraph Company of New York were not slow in acquiring the patents covering this marvelous invention, and the system was extensively utilized. A leading periodical, as early as 1873, speaks of the Edison Automatic Telegraph System as "simply incredible," and gives some interesting details of the speed already attained. "The dispatches of the Press Association from New York and Philadelphia to Washington are sent at the rate of 1000 words per minute in all conditions of the weather, which seriously affects other systems. Between New York and Pittsburgh 800 words are sent, and between New York and Charleston, S. C., a distance by wire of 1050 miles, messages are transmitted at the rate of 300 words per minute, a wire which neither the Morse nor House-Hughes can practically work direct.



ROMAN LETTER PERFORATOR FOR EDISON AUTOMATIC TELEGRAPH.

"It will be seen that the capacity of one wire between New York and Washington is nearly equal to the total mail correspondence between those two centres." We give these early statistics to show how radical was the reform effected even at that comparatively immature stage, and how prompt was its adoption by the enlightened portion of the community.

From the larger facilities afforded by his new premises Edison continued to perfect all the mechanism connected with automatic telegraphy. He also devised a Roman letter system of chemical telegraphy, which he transmitted from Philadelphia and recorded in New York City over three wires to the prodigious number of 7000 words a minute.

The perforating machine for this system is operated very much like a good-sized typewriter, having a key for each letter of the alphabet, as well as extra keys for signs and numerals. Additional numbers of metallic points are used in transmitting and receiving; with this exception, the Roman letter and Morse signs are the same.

It was while experimenting upon chemical telegraphy that

Edison was led to the discovery of the electro-motograph, that is, of its embryotic principles, for the semi-perfected form of the invention was only evolved after six years of severe and persistent study, and the system, according to the inventor, still admits of improvements. The discovery is based upon the fact that "certain chemical salts lose their functional properties when subjected to the action of an electric current." By accepting this principle as a starting point, we have a system of chemical telegraphy in which it is possible to dispense with the

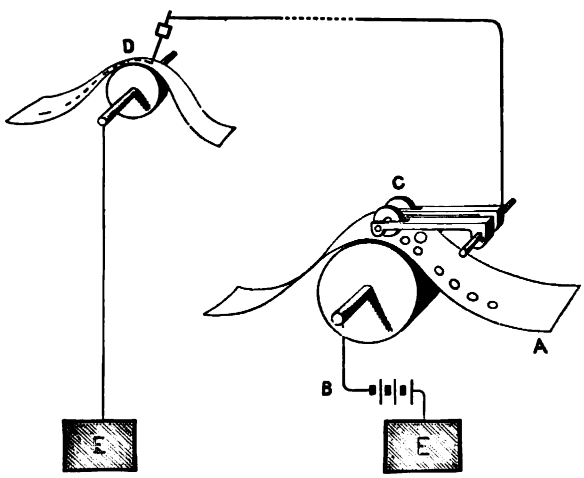
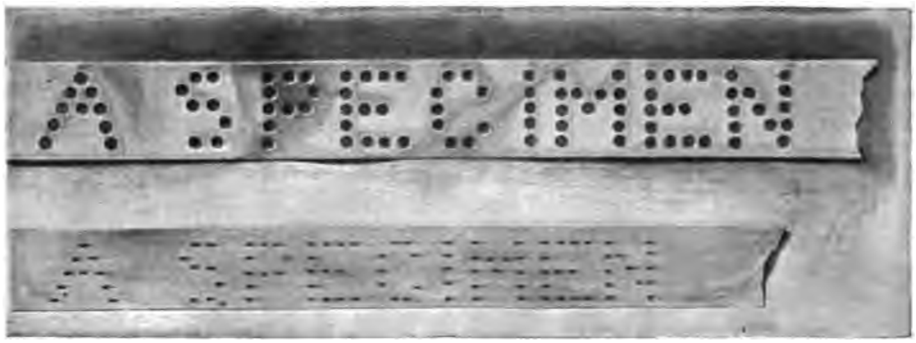


DIAGRAM OF SENDING AND RECEIVING APPARATUS.

ordinary relay magnet, a system in which friction and antifriction are utilized in place of the magnetic power embodied in the relay. Although actuated by an almost inappreciable current, its power of speed is at least ten times that of any magnet in the scientific field, and it is the only instrument susceptible of repeating or translating from one circuit to another the signals of high speed telegraphic systems. But let us enter somewhat more closely into the technical construction of this apparatus. A chalk cylinder, saturated with a salt of mercury

and a strong solution of caustic alkali, is made to revolve at regular speed by turning a crank. One end of a strip of palladium-tipped brass is held against the chalk cylinder by means of a spring, the other end of the strip being hinged to the centre of a mica diaphragm, which in its turn is secured rigidly in a suitable frame. On turning the crank away from the diaphragm, the pressure or friction of the strip, bearing against the chalk, tends to draw the diaphragm in. Should the friction be suddenly lessened, a loud noise would be the result, caused by the diaphragm springing back into position. Therefore, as



SENDING AND RECEIVING STRIPS.

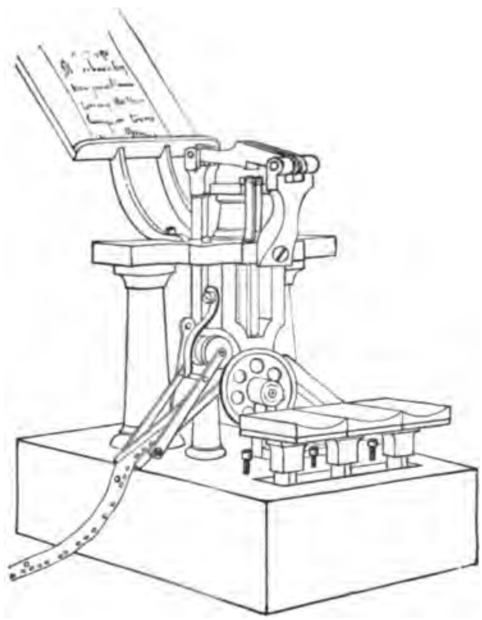
we have seen, the electro-chemical decomposition of the prepared chalk and its resultant smoothness are in proportion to the greater or lesser force of the electric waves transmitted, in obedience to the impulse of the human voice, through the distant Edison carbon-telephone transmitter, varying in strength at the will of the speaker.

Mr. Edison's description of the circumstances under which he was led to the discovery of the motograph is interesting, demonstrating, as it does, the inventor's deeply investigating mind, and his inability to satisfy himself with superficial results.

One day, while engaged on the fruitful problems connected with automatic telegraphy by means of chemically prepared paper, electrically discolored, he took up in his hand the metallic point, through which the current passes to the paper, retaining his loose grasp after the closing of the circuit and permitting the point to rest upon the paper. To his profound astonishment, he noticed that with the closing of the electric current, induced by the motion of the metallic point along the paper, the latter substance gradually lost its rough texture and assumed a soft and lubricated appearance. After hours of careful research, Mr. Edison was led to the belief that friction between the metallic point and the chemically prepared paper was greatly decreased by the passage of the electric current, and that to the alternate opening and closing of the key was due the lubricated condition of the paper. Satisfied with these deductions, he abandoned the experiments for duties of greater moment, expecting to take up the investigation at the same point and under the same conditions. To his amazement the results of the preceding day were no longer within his grasp, and for many months and years these phenomena eluded his investigations with an ingenious persistency nothing short of diabolic. It was not until the summer of 1876 that the solution of the mystery presented itself and the underlying principles of the electro-motograph were practically applied to the production of a variety of important inventions, such as, among others the speaking and musical telephone, and the signaling at distances by the use of bells, irrespective of electro-magnetism. In this latter case, an upright clapper is utilized in place of the diaphragm already described, and this clapper, being released by the making and breaking of the current, strikes the bell.

The principle has been successfully used in lessening the friction incidental to machinery in rapid motion, and has been of

peculiar value in accelerating the defective methods of oceanic cabling. A special electro-motograph was constructed by Mr. Edison in connection with the transmission of oceanic messages, consisting of a very smooth disk of prepared chalk, revolved by clock work upon which a metal arm is made to rest, suspended in the middle by a torsion wire. To this arm is attached a graphite pointer or pencil, under which is a traveling strip of paper.



MORSE PERFORATING MACHINE.

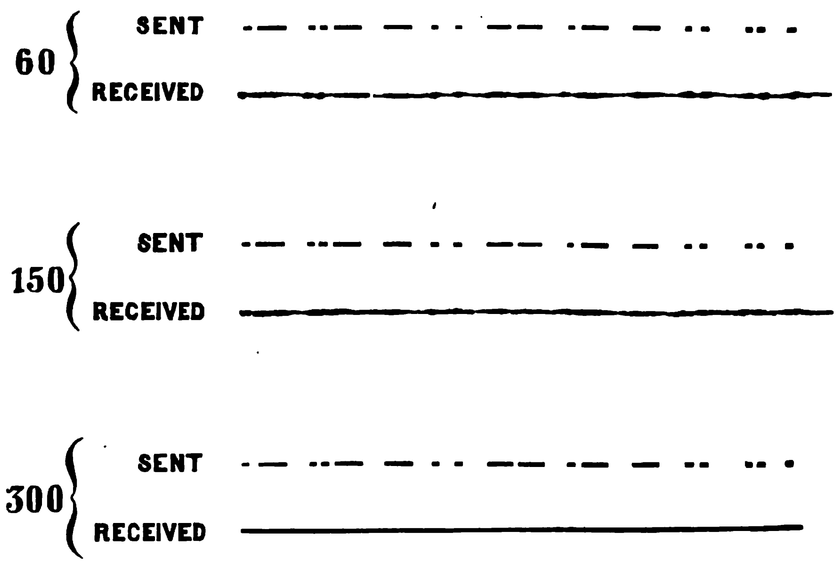
During the revolving of the disk and the cessation of the current, the pencil only marks a single straight line, but should the friction be released by a wave of electricity, the pointer instantly changes its position. By signs, formed according to these methods, a code of signals is easily constructed.

In connection with the carbon telephone the electro-motograph has been of incalculable use in detecting the pulsations of the heart, however feeble, in one whom medical science has pronounced to be dead.

When the horrors of living entombment are taken into question, and the recognized difficulties of establishing the presence of death, the value of this invention will be readily seen.

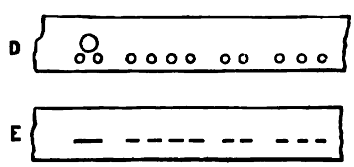
The following is the method employed: over the heart of the patient is placed a carbon receiver of peculiarly sensitive quality, attached by wires and a battery cell to an electro-motograph, constructed in such a fashion as to amplify many degrees the

desired sounds. To the delicately responsive surface of the carbon, the pulses of the heart audibly respond, communicating a series of vibrations to the diaphragm of the electro-motograph.



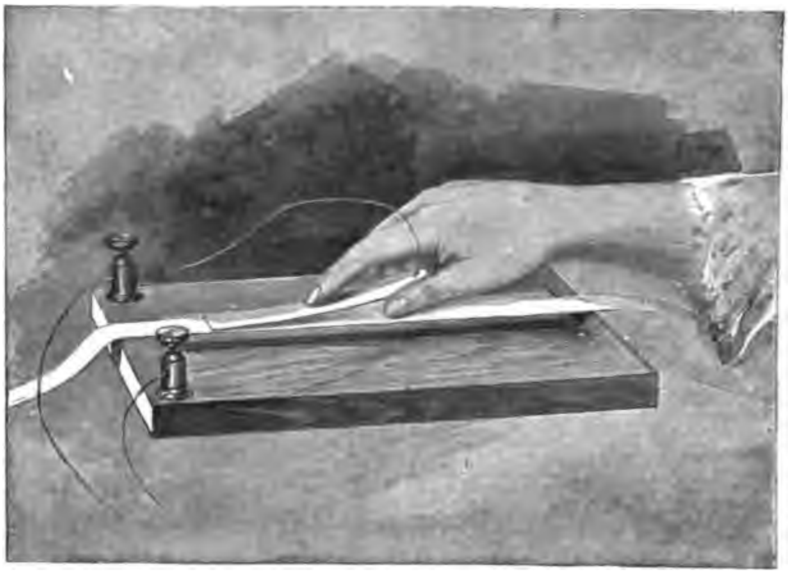
EFFECT OF STATIC DISCHARGE UPON SIGNALS.

This method of sound amplification is immeasurably superior to that effected by the microphone, inasmuch as quantity is attained without injury to the inherent quality of the sound. There is nothing within the practical range of the microphone which may not be attained by the electro-motograph, with results infinitely more favorable to scientific research.



SENDING AND RECEIVING STRIP.

Simultaneous with this line of thought was the discovery of the carbon button, and the indefinite extension of powers concealed within its unpretentious limits. In 1873 Edison's mind was much occupied with the defects attendant upon the transmission of messages over long submarine cables, and while con-

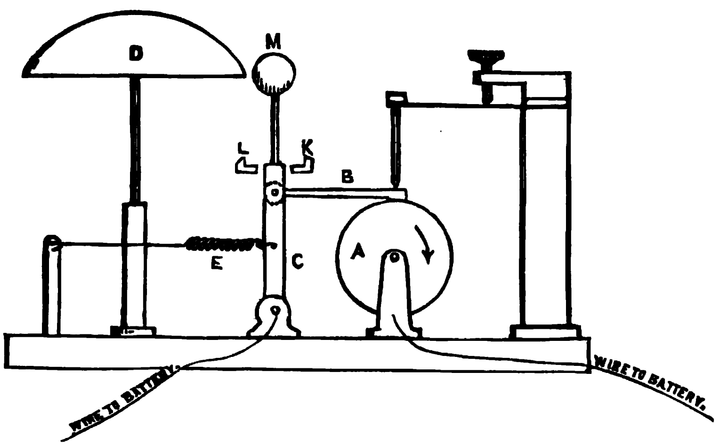


CHEMICALLY PREPARED PAPER AND METALLIC POINT.

structing some rheostats or instruments used for the regulation of resistance in a circuit, he brought into requisition certain powdered substances, such as carbon, plumbago, etc., immured in glass tubes, the variable action of which, under electric pressure, was sufficiently remarkable to engage his attention. It was found that carbon varied its resistance to the passage of electric currents according to the degree of pressure to which it was subjected. This extreme sensitiveness proved at first a source of great annoyance, and after many futile efforts Mr. Edison abandoned the idea as being unsuitable in connection with the nice regulation of resistance in electric circuits. It was not until 1877 that he again took up his disused discoveries, in connection with his ripened efforts in telephonic research, and applied them to a variety of valuable and successful inventions. From this prolific parent have descended the following scientific progeny: The transmitting telephone, the micro-tasimeter, or instrument for discovering inappreciable degrees of heat; the pressure relay, the

carbon rheostat, the hygrometer, or instrument for detecting the slightest moisture; and the odorometer, or instrument for detecting the existence of gases, or odors, ranging from the most pungent to the most delicate.

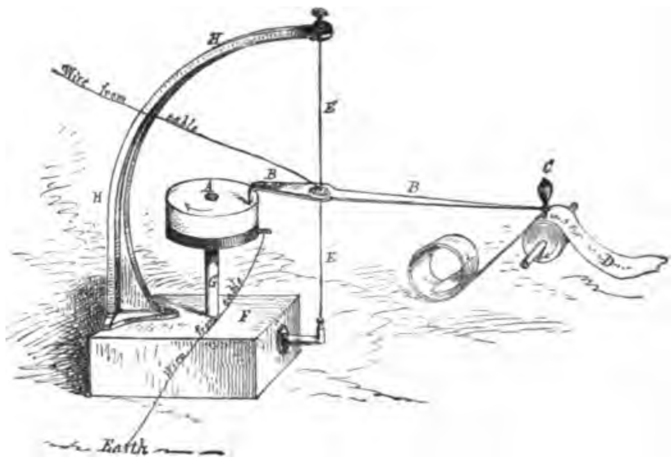
Too much stress can hardly be laid upon the value and originality of the principles contained in the electro-motograph and the carbon button. Of the former it has been authoritatively stated that were the electro-magnet undiscovered, the application of this method would amply suffice for the carrying



MOTOGRAPH FOR SIGNALING AT A DISTANCE.

out of all branches of telegraphy. "It is the most essential of all the means of giving motion," remarks Mr. Edison, "and a telegraphic relay has been made to do the work perfectly by one cell of battery through a resistance of twenty-five million ohms. The rapidity of action is so great that it will repeat signals sent automatically from one telegraphic circuit to another, at the rate of twelve thousand words a minute. Used as a telephone it will render audible, in a large room, conversation sent over a wire several hundred miles long, when the ordinary Bell receiver must be held close to the ear. This

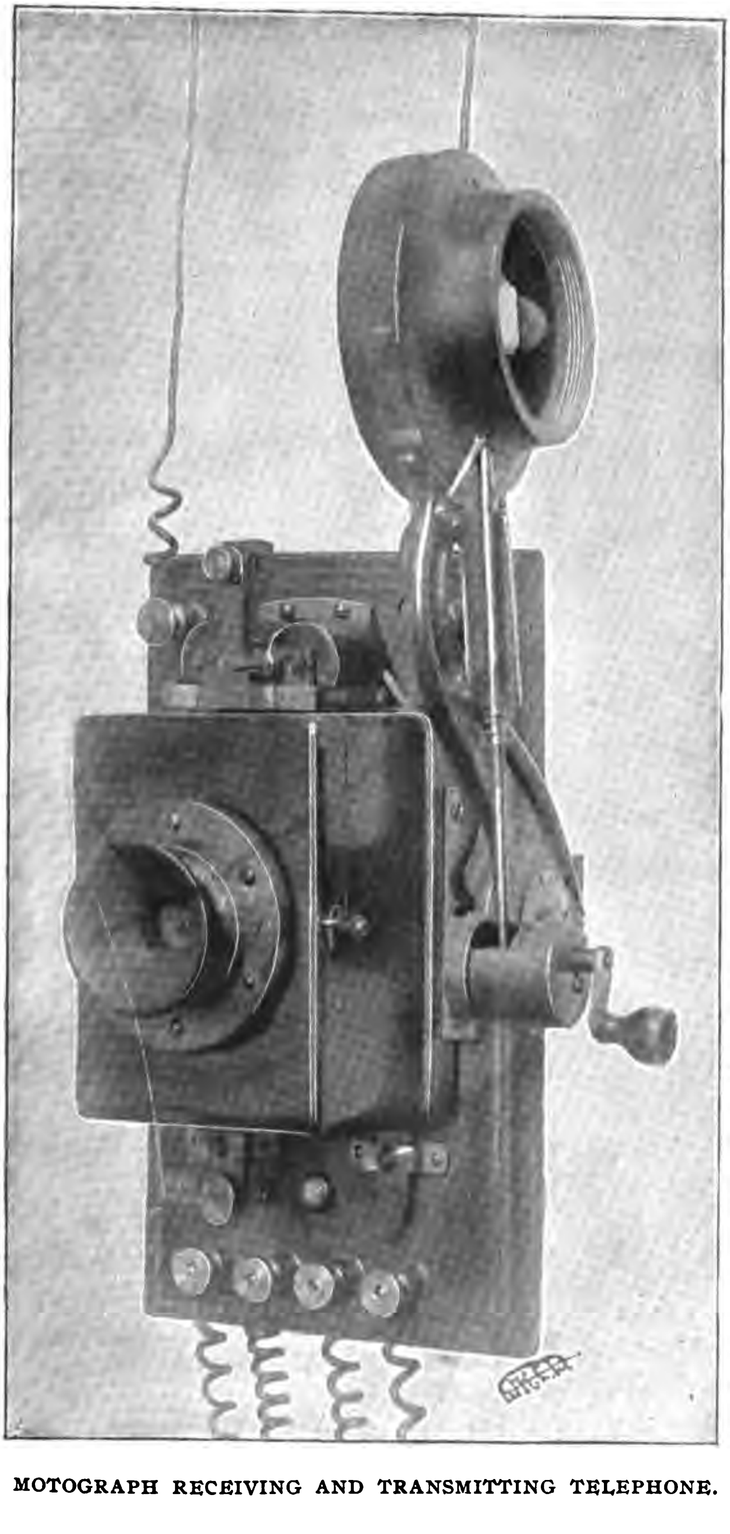
instrument will undoubtedly come into general commercial use as soon as the numerous patents have expired. During the controversy between competitive telegraphers several years ago, one of the companies owned what is called the Page patent, which virtually controlled the use of a magnet acting as a relay; and the motograph, being based on a new and original discovery, entirely evaded the patents. One of the companies was therefore compelled to purchase the patent from me for the sum of



MOTOGRAPH FOR ACCELERATING SPEED IN OCEAN CABLING.

$100,000." The application of this discovery to telephonic uses was brought about in the following manner:

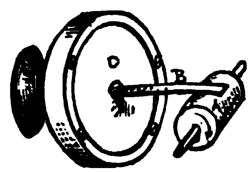
"My agent," says Mr. Edison, "had formed a company in England to exploit the carbon transmitter, the same which is now used so extensively in telephony. The Bell Company also had a company in England and were infringing my transmitter at the same time that I was infringing their receiver. Bell's patent was afterward proved invalid, while my transmitter was sustained, and held the monopoly of the telephone in England for many years."



MOTOGRAPH RECEIVING AND TRANSMITTING TELEPHONE.

A consolidation became imminent. Edison's agent . telegraphed that they would have to resort to that expedient on terms which, as they assured only one-third to the inventor, did not meet with that gentleman's approval.

"I replied by telegraph," says Mr. Edison, "to hold back the negotiations for three weeks, so as to give me time to invent a new receiver, independent of Bell. I then withdrew my whole force from the electric light, which I was then investigating, and put it on telephony." The practical outcome of this concentrated energy was the completion, in one week, of a satisfactory telephone, based upon the new discovery, and in sixteen days twenty instruments were constructed and on their way to England, under charge of two picked experts. The substitution of the new methods for the old took place in the newly established Exchange in London, a consolidation was effected, and Edison's stipulated terms of equal division were acceded to.



CYLINDER AND DIAPHRAGM.

At the risk of somewhat anticipating the chronological sequence of Mr. Edison's inventions, we may state that the loud-speaking telephone proved a signal success in England. It was found, to the amazement of the public, that by the use of a special instrument the reproduced voice could be made louder than that of the original speaker, notwithstanding the loss on the line. Insular prejudices melted before the manifold advantages of the new invention, and the system was successfully grafted upon the social, political and commercial workings of the day.

It will be seen that of the inventions belonging to the first six or seven years of Edison's comparatively untrammeled career, covering the period of his stay in New York and Newark, that is from 1869 to 1876, some were wholly and some were partially matured and clinched by patents. The larger number, however,

were merely rudimentary, containing germs of a perfection which was to be evolved in later years, and under improved facilities. Some brief description of these will be given in chronological order, and under their more matured conditions, but an exhaustive survey of Edison's inventions would constitute, in itself, a moderate sized library, and would be totally out of keeping with a work of the present general character. Any one who attempts the task of even wading through a simple catalogue of his inventions can enter intelligently into the description of the inventor, supplied by the United States Patent Commissioner: "A young man who has kept the path to the Patent Office hot with his footsteps." If this were true of Edison at the comparatively immature age of twenty-four, what may not be claimed for him now, with twenty years of past scientific successes, and the promise of countless better things to come?

CHAPTER VI.

A NEW ERA. EDISON'S MARRIAGE. HIS PHENOMENAL POWERS OF ENDURANCE. HIS VIEWS ON DIETETICS AND REPOSE. FURTHER DEVELOPMENT OF QUADRUPLEX. REMOVAL TO MENLO PARK. EDISON AND HIS CHIEF ASSISTANTS.

THE individual mistress of Edison's heart until now had been science, but a new potency was at hand, equally strong, but immeasurably more subtle and all-pervading. For

> "Love first learned in a lady's eyes,
> But with the motion of all elements
> Courses as swift as thought in every power,
> And gives to every power a double power
> Above their functions and their offices."

In the person of Miss Mary E. Stillwell, Edison again enjoyed the gentle and uplifting influence of which he had been deprived by the death of his mother. The courtship was brief, simple, and tinged by Edison's characteristic humor, and the marriage took place in 1873.

Mary E. Stillwell belonged to that rare order of women who are prepared to admit the inevitable nature of certain existing conditions, and who do not exact as a primary concession to their new-fledged dignity the sacrifice of all pre-marital claims. By the exercise of this delicate tact, this wise effacement of self, Mrs. Edison's influence acquired a deeper force and subtlety, permeating the multiform strata of her husband's

life, instead of constituting a personality apart, remote, chilly and exacting. She was greatly beloved by the men in Edison's employ, who to this day dwell admiringly upon her superior characteristics.

Previous to her marriage she had been a member of the inventor's working force and, despite her new dignities, ever retained an affectionate interest in her former associates. Three children, a girl and two boys, were born of this union, Marian and Thomas Alva (familiarly known as Dot and Dash), and William Leslie. Edison's marriage brought with it, among other good things, sundry improved hygienic conditions, notably those attaching to repose. It cannot be said that the reform was a radical one, or that the scientific sinner was not subject to frequent and alarming relapses, but, on the whole, certain unsuspected sparks of sanity were brought into view. Prior to his marriage Edison portioned out his hours of sleep and waking, of food and abstinence, not by the arbitrary division of light and darkness, but by the ebb and flow of the Divine afflatus. When the sacred fires of inspiration descended upon him, the vulgar requirements of hunger and fatigue were relegated to the limbo of extinct institutions, and the scientific annals of the Newark laboratory testify to the most abnormal stretches of endurance, followed, however, by equally protracted periods of rest.

On one occasion, having received an order to supply $30,000 worth of his gold and stock quotation printer, and finding that for some occult reason the new instruments refused to work, Edison immured himself on the top floor of the factory, together with a handful of scientific devotees, and conveyed to his followers the pleasing information that there he proposed to have them remain until such time as the printer was in smooth working order. "Now, you fellows," said the determined inventor, "I've locked the door and you'll have to stay here until this

"YOU'LL STAY HERE TILL THIS JOB IS COMPLETED."

job is completed." And they did stay. Sixty hours of physical and mental work ensued, unbroken by sleep and scarcely by food, at the end of which time the difficulty was discovered and rectified. After thirty-six hours of sleep, which followed upon this phenomenal effort, Edison awoke invigorated, luminous of intellect and fully equal to the exigencies of new situations.

It has been claimed, and with perfect justice, that these extraordinary powers of physical endurance, this ability to dispense with sleep and sustenance, this swift power of recuperation could only be found in a physique the pure currents of which had never been vitiated by dissipation. A more potent argument in favor of total abstinence could hardly be adduced than that embodied in Edison's career. His severe and protracted labors owe their sustained brilliancy to no artificial stimulus; no alcohol, morphine or cocaine have touched his lips, and nature finds it comparatively easy to repair the ravages inflicted by painful and continued thought. With the generality of mental workers the cerebral tension is not merely coexistent with the period of toil, but lasts long after the object has been achieved, crowding the brain with distracting images and promoting a state of acute nervous excitement. With Edison, on the contrary, the effort at relaxation is instantaneously successful. The blood, after having served the purpose of stimulating the capillary vessels of the brain and inducing inventive capacity, soon retreats quietly to its legitimate source, and upon tired eyes, restless limbs and feverish energies descends

> "The honey heavy dew of slumber,
> * * * * *
> Death of each day's life. Sore labor's bath."

Edison's views as to sleep were on a par with his theories in regard to diet. These were of so original and impracticable a nature that had they not been tinged with the inventor's customary humor and brought to bear upon the fine mental

equipoise of his wife, carnage and conflagration must have been the result. "I wish I might never eat the same thing twice in a month," was Edison's feeling aspiration at the outset of his domestic career. We can imagine the sensations of an affectionate and inexperienced housekeeper, confronted with this unattainable desire on the part of her spouse, casting about wildly for methods wherein to embody his views and finding her ambition cramped by insufficient means, limited culinary skill, and the unkind influences of a New Jersey soil; we can picture her envious contemplation of Mrs. Noah's superior facilities, and her fervent asseveration, like another harassed housekeeper we wot of, that "a deluge would be a trivial penalty to pay for the privilege of finding one's self on a revolutionized earth, with a brand new set of animals, vegetables and fruits."

It must not be concluded that Edison is an epicure and enslaved by the pleasures of the table. On the contrary, as we have already seen, he is singularly abstemious, eschewing all alcoholic stimulants, and averse to prolonged and heavy eating. At the same time his palate is, or perhaps we should say was, extremely capricious, craving a succession of delicate and varied cates, such as the culinary skill of our degenerate race is totally unable to supply.

He holds that a close analogy exists between physical and spiritual laws, and that considerable light may be thrown upon the dim and untraveled confines of the human soul by an exact scrutiny of its corporeal encasement. Acting on these premises he claims that the human palate is as dependent on the variety and quality of its food as is the mind on its corresponding intellectual pabulum, and that in proportion to the elastic requirements of the diet will be the scope and potency of the mental powers. He bases these assertions on the dietary and intellectual statistics of the several nationalities, and supports his arguments with considerable ingenuity.

"Variety," Edison remarked, "is the secret of wise eating. The nations that eat the most kinds of food are the greatest nations."

These sapient observations were delivered in 1878 over a repast so ephemeral as to remind us of Ouida's impossible banquets, where the ethereal heroine toys with a pheasant, coquets with a chocolate éclair, or trifles with the rose-hued bubbles of rare wines in a way calculated to dishearten the most enthusiastic pupil of the romantic school. A wide-eyed waiter, in obedience to the guest's instructions, brought a plate of strawberry shortcake, a dish of strawberries and cream and an apple dumpling, in conjunction with which the following themes were discussed:

"Rice-eating nations never progress," continued Edison, "they never think or act anything but rice, rice, rice for ever. Look at the potato and black bread eaters of Ireland; though naturally bright, the Irish in Ireland are enervated by the uniformity of their food. Look at the semi-savages who inhabit the Black Forest. On the other hand, what is, take it all in all, the most highly enlightened nation, the most thrifty, graceful, cultured and accomplished? Why, France of course, where the cuisine has infinite variety. When the Roman Empire was at its height the table was a marvel of diversity; they fed on nightingales' tongues and all sorts of dainty dishes. So when Carthage was in her glory"—

To the question as to whether the orator agreed with the Phœnician axiom that the stomach was the seat of wisdom, Mr. Edison emphatically assented, adding:

"Some say I get the cart before the horse, and that the diversified food is the result of a high civilization rather than its cause, but I think I am right about it. A nation begins to decay, philosophically and morally, as soon as cooking is degraded from an art to an occupation."

Mr. Edison's youthful convictions have yielded in great measure to the larger views of his ripened manhood, and it is well that this should be so, for history, whether of the past or the present, will scarcely be found to substantiate his assertions. The intellectual and moral apotheosis of a nation has not necessarily been the outcome of its perfection in and devotion to the culinary art. With the wanton splendor and profusion of the Oriental and Latinic races came the sapping of intellectual power, the degradation of the moral sense, the fatal cleavage of political unity. A sickly and mercurial sentimentality, born of wine-cups, surfeits, and fetid atmospheres, usurped the place of pure and constant affection; an unreal miasma, wherein floated the diseased fancies of poetasters and pedants, supplanted the fair and potent ideals of true poetry and romance, and an illogical and unbridled license was substituted for that glorious enfranchisement which is the inalienable heritage of the sons of God. Such mental and moral endowments as owe their birth to the wine-cup or the flesh-pot are meretricious and ephemeral and contain no germ of that true spiritual vitality which is not only independent of carnal support, but which holds and wields its imperial prerogative of molding to its own finer purposes the gross elements of this "muddy vesture of decay."

What share had the banqueting hall of Nebuchadnezzar the King "in the knowledge and skill in all learning and wisdom" which was the portion of those pulse-fed exiles on the shores of Babylon? Could a diet, ranging from the Plutonian broths of Sparta to the artistic creations of a modern French cook, have lent greater breadth and delicacy to the multiform harmonies of Shakespeare than was evolved from the gross cates of the Elizabethan age? Could a regimen of "Herbs and such like country messes" have imparted a more delicious pastoral flavor to the *Allegretto* and the *Lycidas?* Could a beaker of


PHOTO BY W. K. L. DICKSON

EDISON CAUGHT AT WORK IN HIS ORANGE LABORATORY.

Parnassus dews or a draught of Chian wine, cooled with Olympian snows and tempered by honey from the violet-scented slopes of Hymettus, have enhanced the incomparable grace and sweetness of "Una" or the "Faerie Queene"? We trow not.

However open to individual opinion Edison's views as to dietetics and repose may have been, and however unadvisable it might prove for less favored mortals to adopt his methods, the practical outcome of these early years was excellent from the standpoint of creative energy; 1874 was noted for the birth of the famous quadruplex telegraph, a partial description of which has already been given.

The appearance of such an important invention could not but be attended by counter-claims, the bulk of which were enforced with extreme bitterness and complicated legal suits, but the incontestable superiority of Edison's methods gained the day, and the new system spread rapidly over the world.

The experimental work relating to the quadruplex was carried out as rapidly as practicable in the Newark laboratory, but it was eventually transferred to the Western Union telegraph office in New York, where several months were spent in improving the apparatus. A complete set was finally made, and one of Edison's assistants was despatched to Boston, the instruments being arranged and manned by competent operators. In a few minutes proper adjustments were obtained, and a swift and satisfactory transmission secured, which suffered no diminution during the lengthened period of its transmission. The invention was of transcendent value and spread rapidly over the whole country. "Even the English goat," remarks Mr. Edison gleefully, "was forced to collapse and pay me a royalty for many years."

The president of the Western Union stated four years afterward in his annual report that the invention was "one of the most important in telegraphy and had saved the company

$600,000 annually." At the present time the quadruplex takes the place of several million dollars' worth of wires and poles.

For this magnificent invention Edison received a very modest sum, the whole of which was expended in the development of an octuplex, or instrument for transmitting eight messages simultaneously over one wire.

"This," said Mr. Edison recently, "I never completed, having taken up what is called the acoustic telegraph, which led to the invention of the modern commercial telephone. Bell, Gray and I were experimenting with acoustic telegraphy. Bell patented an acoustic telegraph, which was subsequently found capable of transmitting articulate speech. While this was being exhibited at Philadelphia I devised a transmitter, in which carbon was employed to translate sound into electric waves, and Gray had filed a caveat wherein water was used to vary the electric current. Bell's instrument was taken up by Boston capitalists, while mine was adopted by the Western Union, and a fierce competition ensued. It was seen by the Bell people that their instrument was impracticable for commercial purposes without my transmitter, and *pro contra* by the Western Union, that without Bell's receiver, which they did not own, my instrument was not available without extensive litigation, so a consolidation of interests took place. I met the objections to the lack of a receiver by inventing one based upon a hitherto unknown phenomenon, but the negotiations had gone too far to admit of this being utilized, and aware of my tendency to spend every thing in experimenting, I bargained that the sum paid should extend over a period of seventeen years in monthly payments, to which the company only too gladly acceded."

With the passage of time from 1870 to 1876 came the demand for increased facilities, necessitated by the extension of Edison's works. The vast and varied nature of his schemes brought many things into requisition which were unattainable in

EDISON'S MENLO PARK LABORATORY IN THE WINTER OF 1879.

the Newark premises, illimitable as these had appeared in comparison with his former surroundings. It is estimated that at this period no less than 45 distinct inventions were in different processes of completion, and that the financial profits resulting from the manufactury and sale of patents, amounted to about $400,000, all of which was promptly reinvested in further experiments. Edison's growing celebrity, moreover, brought with it certain penalties which were as distasteful to his nature as they were destructive to his pursuits. Visitors thronged the Newark laboratory, some impelled by a genuine love of science, but the larger number actuated by mere vulgar curiosity. It was in a large measure to escape from these that Edison moved himself, his family, and his impedimenta to Menlo Park, a quiet spot on the New York and Philadelphia Railroad, at a distance of twenty-four miles from New York.

There he built and fitted up a laboratory, so extensive and so magnificently appointed as to stand foremost among establishments of a kindred nature.

"When the public tracks me out here," remarked Mr. Edison, "I shall simply have to take to the woods."

Mr. Edison expended no less than $100,000 on his experimental apparatus alone, and the other facilities were obtained at a correspondingly high cost. A workshop, one hundred feet in length, by thirty-five feet, was appointed with every mechanical detail demanded by the varied scope of science, comprising milling machines, lathes, punches, drills, planers, etc., all of exceptionable make. The power was supplied by a Brown engine of eighty horse-power. Delicate instruments of precision, models of completed machines, Morse sounders, galvanometers, telegraphic keys, a thermo pile, safe-locks and a variety of objects too numerous for classification; these were grouped in a profusion which must have gladdened the acquisitive mind of the inventor, so long and seriously balked by the paucity of mechanical facilities.

A costly scientific library, composed of the newest and most reliable works of reference, formed an important feature of the establishment, and contributed largely toward the pleasure and profit of its inmates. The upper portion of the building was well lighted, well ventilated, and commodious, walled about by endless strata of heterogeneous articles. Rows of phials, chemical appliances, botanical specimens, rare minerals, hideous varieties of preserved snakes and other reptiles, conical paper funnels six feet high, cases of every ordinary and extraordinary device born of that prolific parent, necessity; these, together with the usual laboratory fixtures and experimental appliances, such as microscopes, insulators, spark generators, air pumps, litre measurements, etc., were present in the most wanton variety and profusion. A pipe organ, of fairly good tone and dimensions, and a diminutive music box occupied one corner of the premises, and were frequently brought into requisition whenever, in Mr. Edison's opinion, music's magic strains were needed to soothe the savage breasts of his employees. From every available quarter dangled festoons of wire, the occult possibilities of which were sufficient to ensure a respectful avoidance on the part of visitors. No one knew whether or not a pass to the other life lay concealed within these innocent-looking metallic threads, and no one was sufficiently out of touch with "this work-a-day world" to put the supposition to the test.

A species of glorified mist soon enveloped "the wizard of Menlo Park," through which loomed, like spectres of the Brocken, the grotesque and exaggerated reports of his powers. By the simple inhabitants of the region he was regarded with a kind of uncanny fascination, somewhat similar to that inspired by Dr. Faustus of old, and no feat, however startling, would have been considered too great for his occult attainments. Had the skies overspreading Menlo Park been suddenly darkened by a flotilla of air-ships from the planet Mars, and had Edison been

EDISON AND HIS CHIEF ASSISTANTS AT MENLO PARK IN 1878.

discovered in affectionate converse with a deputation of Martial scientists, the phenomenon would have been accepted as a proper concession to the scientist's genius.

Tales of the wildest description as to Edison's achievements, his personal life and his business relations found ready credence, and we find the *Paris Figaro* of 1878 indulging in a vein of brilliant and unadulterated imagination, such as Gallic records would find it hard to outstrip. Under the thrilling title of "Cet étonnant Eddison" (This astonishing Edison), the publication launches into details of the inventor's career, prefacing his sketch by the following lucid and eloquent description of the newly completed aerophone.

He informs the public that the Paris Exhibition is now the richer by the celebrated "Eddison's" latest invention, the stupendous aerophone, of which the workings may be thus briefly outlined: "It is a steam machine which carries the voice a distance of eight kilometres. You speak in the jet of vapor; a friend previously warned understands readily words at a distance of two leagues. Let us add that the friend can answer you by the same method."

It would be superfluous to enlarge on the profundity and clarity of this unique description. We will, therefore, proceed with the *Figaro's* further revelations, which cannot but possess the merit of entire novelty to the reader.

"It should be understood," continues our Gallic oracle, "that Mr. Eddison does not belong to himself; he is the property of the telegraph company, which lodges him in New York at a superb hotel, keeps him on a luxurious footing and pays him a formidable salary, so as to be the one to know of and profit by his discoveries. This company has, in the dwelling of Eddison, men in its employ who do not quit him for a moment, at the table, on the street, in the laboratory. So that this wretched man, watched as never was a malefactor, cannot

give a second's thought to his personal affairs without one of his guards saying: 'Mr. Eddison, à quoi pensez-vous?'"

It is amusing to compare this figment of a callow reporter's imagination with the true and unvarnished facts.

"Cet étonnant Eddison" was indeed a sufficiently astonishing individual in the estimation of his employers to enjoy their confidence and respect, but had that respectful treatment been withheld, Edison's sturdy nature would have known how to command it. As a matter of fact, his scientific investigations were absolutely free from espionage, and his flow of genius untrammeled by interference or suspicion. He was singularly fortunate, moreover, in gathering about him elements of a congenial nature, and in welding these into one efficient and harmonious whole. A corps of skilled mechanics had been secured at the outset of the new enterprise, and a staff of competent assistants, foremost amongst whom was Mr. Charles Bachelor, a gentleman upon whose recognized ability it seems almost superfluous to enlarge. A native of London, England, Mr. Bachelor's sturdy Saxon mind had grafted upon its intrinsic solidity of attainment the acute brilliancy peculiar to this rarefied American air, together with the alert business capacity so necessary to worldly success. This rare combination of intellectual and commercial powers had made him indispensable to Mr. Edison, with whom he had been closely connected since the year 1870. Well has it been said in regard to the relations subsisting between the two friends and associates: "If a historical parallel will be allowable, Mr. Bachelor is to Mr. Edison what Father Mersenne was to the great Pascal, the celebrated scientist, scholar, and inventor of the arithmetic machine."

Under Mr. Bachelor's supervision were placed eleven of the most skillful machinists and instrument workers attainable. Prof. McIntyre, a scholar of no mean reputation, with two competent assistants, carried out the scientific experiments,

invariably outlined by the inventor himself; while Mr. L. S. Griffin, his life-long friend and former telegraphic manager, assumed the congenial task of private secretaryship, promoting, by his affectionate and intelligent zeal, the confidential interests of his employer. Mr. John Kreuzi officiated as master machinist, and William Carman as bookkeeper. The services of the entire force were on a salaried basis, with the exception of Mr. Charles Bachelor, to whom, in view of his valuable co-operation, an interest upon each invention was paid.

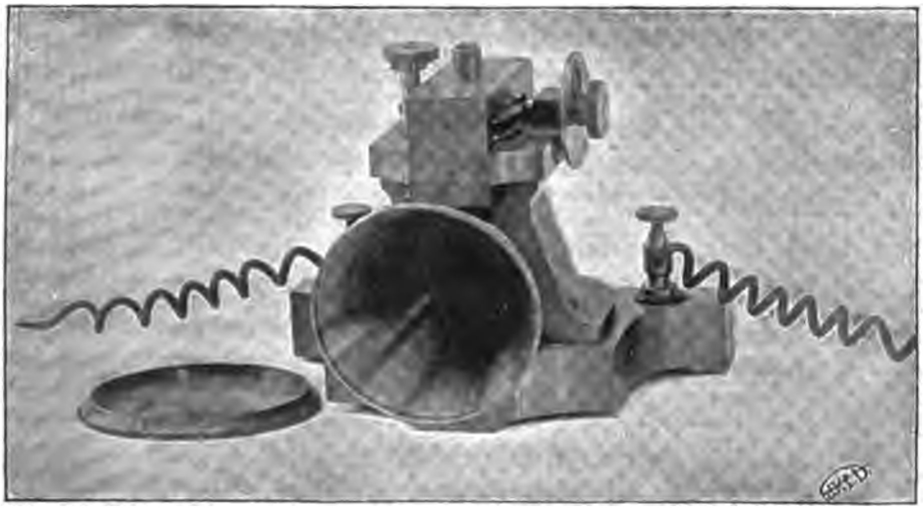
The genius of good will, whose presence had been so marked a feature in the Newark laboratory, found a congenial abiding place in Edison's new surroundings, and the social machinery moved as smoothly as the complicated gear, lubricated by spiritual substances infinitely more potent and subtle than material oils.

CHAPTER VII.

THE MICRO-TASIMETER. MOLECULAR MUSIC. REGISTRATION OF SOLAR ECLIPSE. SENSITIVENESS OF TASIMETER. THE ODOROSCOPE. THE MICROPHONE.

THE micro-tasimeter, or instrument for measuring inappreciable degrees of heat, was now evolved, being based, as the reader will remember, upon the variable resistance of carbon under electrical pressure. The name is taken from two Greek words, meaning respectively measure and extension, for the reason that, broadly understood, the office of the instrument is primarily to measure extension of any nature whatever. The principles underlying this delicate mechanism are thus described by Mr. Edison: "It consists of a carbon button placed between two metallic plates. A current of electricity is passed through one plate, then through the carbon, and through the other plate. A piece of hard rubber or of gelatine is so supported as to press against these plates. The whole is then placed in connection with a galvanometer and an electric battery. Heat causes the strip of rubber to expand and press the plates closer together on the carbon, allows more current to pass through and deflects the needle of the galvanometer. Cold decreases the pressure. Moisture near the strip of the gelatine can be measured in the same way by increasing or decreasing the pressure, and accordingly deflecting the needle. By means of this apparatus, or one combined with sensitive electrical galvanometers, it is possible to measure the millionth part of a degree Fahrenheit."

That suggestive poetry which has a knack of filtering through our most prosaic themes leavened the first experiments of the tasimeter. On one occasion Edison heated the handle of a telephone and immediately after spoke through it to his trusty associate, Mr. Charles Bachelor. That gentleman promptly replied, in somewhat excited tones, "Why, Edison, what are you doing there? Where does that music come from?" Edison



EDISON'S MICRO-TASIMETER.

disclaimed the existence of music at his end of the line, but repeated tests secured similar effects, and the fact was established that a musical note of peculiar sweetness and sonority could be produced at intervals of five seconds, resulting, as subsequent investigations proved, from the gradual contraction of the molecules in the process of cooling. This curious phenomenon was named by Mr. Edison, "molecular music."

Had Pythagoras been personally conducting that memorable experiment, he would probably have detected in those silvery monotones some distant re-echoes of his own beloved strains,

the hypothetical march of the planets. As it is, what unsuspected harmonies may not be awaiting us in the unexplored regions of molecular sounds?

On July 9, 1878, at Rawlings, Wy. Ter., and on the occasion of the sun's total eclipse, the tasimeter was subjected to its first crucial test, under circumstances of a somewhat adverse nature, and in a shrine the nature of which was calculated to shock any youthful romance which may have lingered in the young scientist's breast. On Edison's arrival at the seat of operations, he found that every available structure had been seized upon and utilized by the innumerable crowd whom curiosity or scientific ardor had attracted to the spot, and that the only edifice at his command was a dilapidated hen-house. Here he established himself, with his various impedimenta. A stable and level basis was the first indispensable requirement of the delicately sensitive apparatus, and this element was conspicuous by its absence on the present occasion. Not only was the hen-house in the last stage of consistent decay, but a blizzard was in progress, second only to Mark Twain's celebrated Washoe zephyr, or the antics of Odysseus' escaped breezes. Edison's observatory began to rock in the most ominous manner, and one side assumed a pensive angle, resembling that of the leaning tower of Pisa. Each vibration affected the condition of the tasimeter, and brought new adjustments into requisition. Time was coursing swiftly, and the supreme moment of observation was at hand. The assembled scientists were quivering with pent-up excitement, and the success or non-success of the new invention was not the least important theme of speculation. Edison surveyed his tottering structure in momentary despair, while the wild winds played havoc with his raiment and with his scientific apparatus. The storm had descended in too violent and unexpected a manner, and the time was too short for demolishing and reconstructing, therefore Edison did the only

thing possible under the circumstances. Tearing into a neighboring lumber yard, he impressed a dozen burly men into service, and succeeded with their help in propping up the side of the hen-house, besides erecting a broad fence wherewith to break the force of the tornado. Scarcely were these preparations completed when the chronometer indicated half-past one o'clock. At thirteen minutes after two the moon began her passage between the sun and the earth. The tasimeter was again adjusted, but so violent were the oscillations communicated to the projected telescope, through the violence of the gale, that no satisfactory results could be obtained.

A partial equilibrium was secured by a hasty arrangement of wires and ropes, the instruments were again adjusted, and simultaneously with Dr. Draper's excited announcement, "There she goes!" the smoked glasses of innumerable spectators were riveted on the celestial phenomenon. The progress of the moon was slowly traced through the successive hours and no difficulties were experienced except the ones in connection with Edison's gallinacious and recalcitrant structure.

At five minutes past 3 P. M., the sun's disk was seven-eighths covered, and the surrounding country loomed faintly through a dim, sepulchral light. At a quarter past three all animal life was quiescent, and darkness was on the face of the earth. Still the tornado howled and rampaged, and that miserable tasimeter meekly took its cue from the raging elements. Pitted against the forces of nature, Edison stood his ground valiantly, adjusting and readjusting his instruments, until at length, when but one precious moment remained of total eclipse, he succeeded in concentrating the light from the corona upon the opening of the tasimeter, registering the existence of about fifteen times more heat than was discoverable the night before from the star Arcturus.

Accurate results, however, were impossible, owing to the

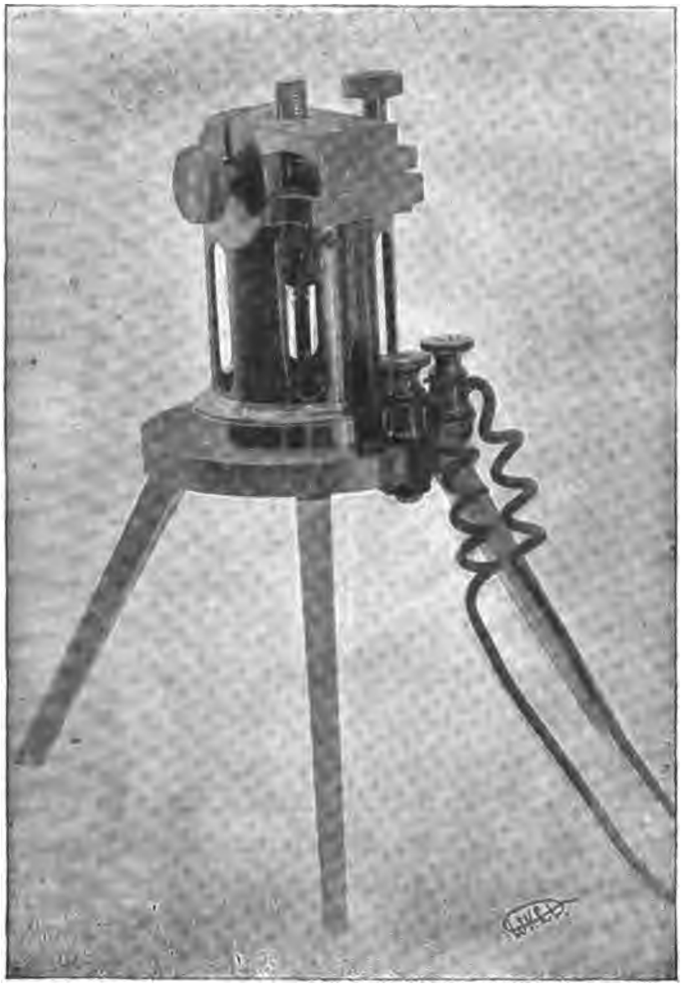
shortness of time, but one important principle was obtained and cherished in the inventor's mind for further investigation. Not only was the capacity of the instrument found sufficient for the registration of the desired phenomenon, but it was discovered that the heat from the sun's corona went ten times beyond the index capacity of the instrument.

This event brought the tasimeter into prominent notice, and a writer in the *Scientific American* of October, 1878, said: "Seeing that the tasimeter is affected by a wider range of etheric undulations than the eye can take cognizance of, and is withal far more acutely sensitive, the probabilities are that it will open up hitherto inaccessible regions of space and possibly extend the range of aerial knowledge as far beyond the limit obtained by the telescope as that is beyond the narrow reach of unaided vision. Possibly, too, it may bring within human ken a vast multitude of nearer bodies—burnt out suns or feebly reflecting planets, now unknown because not luminous."

It is almost impossible for the human mind to realize the fairy-like sensitiveness of the tasimeter. Innumerable experiments were made by Mr. Edison and others which tended toward the demonstration of this fact, and of these we cull the following from a letter of the inventor to Mr. W. F. Barrett, Royal College of Science for Ireland, Dublin (1878), in which Edison says: "By holding a lighted cigar several feet away I have thrown the light right off the scale, and by increasing the delicacy of the galvanometer the tasimeter may be made so sensitive that the heat from your body, while standing eight feet away from and in a line with the cone, will throw the light off the scale, and the radiance from a gas jet 100 feet away gives a sensible deflection."

The pressure of moisture is susceptible of the same minute observations, making the principles involved an excellent basis for the construction of barometers, hydrometers and other appli-

ances for discovering atmospheric conditions. On one occasion, in the early days of his experiments, Mr. Edison placed a strip of gelatine between the upright pieces of carbon. He then held



THE EDISON ODOROSCOPE.

a strip of damp paper three inches away from the gelatine, which instantly produced an expansion of the latter and caused the needle to shift eight degrees. A drop of water on the tip of

the finger, held five inches away, deflected the needle eleven degrees. An important application of these principles is embodied in the detection of icebergs at sea. The carbon button, with its pressing rod, is enclosed in a case, connected with the keel of a ship, and linked by wires running from a constant and weak Daniell battery to an ordinary galvanometer in the captain's room. Cold causes the compressing rod to contract and warmth to expand, and the deflections corresponding to these phenomena are brought at once under the captain's notice, so promptly as to allow ample time for precautions. Long before this ice-mailed colossus of the seas can bear down upon its fragile antagonist, the latter has taken an ingenious *volte de face*, and is skimming merrily in the opposite direction. The sudden breaking out of fires may be chronicled with the same certainty and promptitude.

The conditions relating to the registration of moisture belong properly to the province of the odoroscope, a modification of the tasimeter, and so named primarily from its ability to measure odors inappreciable to the unaided senses.

Various instruments for the projection, registration and amplification of sound were then rapidly evolved. To this order belong, among others, the microphone, the megaphone, the phonograph, and an application of phonographic principles called the aerophone.

The microphone bears a family resemblance to the telephone, with this important difference, that it magnifies the sound in the process of transmission. In the development of this mechanism Mr. Edison embodied the truth that if carbon varies in electrical resistance with variation in pressure, this variation must be heightened to an indefinite degree if the carbon be permitted to make a loose contact with its partners in the electrical circuit. This principle receives extensive application in all microphones used in connection with telephony. Struck by the increased loudness of the sounds, resulting from the multiplication of

contacts, and the consequent exaggeration of the variations in resistance, Mr. Edison was led to the construction of a microphone having a number of upright carbon pieces, each supported by a light spring. To the diaphragm is attached a carbon button, our old Protean friend, against which the first carbon rests, and the vibrations in the diaphragm are passed successively from carbon one to carbon two, and so on, with the result of heightening to a marvelous degree the sounds communicated to the telephone receiver.

In the evolution of the microphone, Mr. Edison was confronted by a formidable antagonist in the person of Professor Hughes, and many choice flowers of rhetoric found their way into the daily papers. The honors of the field remained eventually with Edison, but the pretensions of his rival are among the few circumstances connected with his scientific career which have succeeded in ruffling the serene tides of his philosophical nature. "One of the biggest steals ever made," was Edison's vigorous remark at the time, "filched directly from my telephone."

An abnormal degree of credulity is required to appreciate the capabilities of the microphone. The passage of a delicate camel's hair brush was magnified into an impetuous roar, resembling the progress of a mighty wind through the resonant foliage of giant pines; a tiny gnat, on "light, fantastic toe," gave forth a sound like the tramping of Roman cohorts; while such infinitesimal sounds as the ticking of a watch and the pulsations of the heart, were distinctly audible through a distance representing 100 miles of space. Instances might be indefinitely multiplied, but these are sufficient for the purpose of demonstration.

CHAPTER VIII.

THE MEGAPHONE AND AEROPHONE. SPEAKING OVER LONG DISTANCES WITHOUT WIRES. SOME ENCHANTING POSSIBILITIES OF THE INVENTIONS.

THE megaphone and aerophone are two of Edison's inventions which have had no commercial application as yet.

The megaphone is a contrivance by which remote sounds may be brought within immediate range of the hearing, without any other medium but the air and a couple of funnels, six feet in height, and mounted on a tripod. These taper from a diameter of two feet six inches at the mouth to a small aperture, attached to which are tubes for the ears.

Persons several miles apart have been known to converse with perfect ease, and what must appear even more incredible, the sound of cattle crunching grass, six miles away, has been distinctly audible to the denizens of Menlo Park. In the construction of the aerophone the same tympanum is used as in the phonograph, but the imitation of the human voice is secured, not by the photographing of the sound waves, but by the opening and shutting of certain delicate valves, placed within a steam whistle or organ pipe, and serving the purpose of controlling the requisite amount of steam or air. The vibrations of the diaphragm, communicated to the valves, cause the latter to close and unclose synchronously with the inflexions of the

human voice, the steam or air reproduces these vibrations, and the result is an instrument capable of magnifying two hundred times the ordinary tones of speech, and projecting these to an indefinite distance. It is, in fact, a malicious aggravation of the phonograph, which limits itself to reproducing the ordinary inflexions of speech, etc., but which does not presume to tamper

EDISON AND HIS CHIEF ASSISTANTS, 1889.

with their original volume. The aerophone, on the contrary, not only intercepts casual and indiscreet remarks, but roars them out to the adjoining neighborhood in a manner calculated to endanger the bulwarks of social life. This, at least, was the verdict of the public, when confronted with Edison's new invention, and their attitude was one of comic wrath toward appliances which seemed to threaten their cherished privacy. When

we take into consideration the meagreness of our justice, "the rarity of Christian charity, under the sun," the proneness to evil deduction, the thousand hypocrisies engendered by the arbitrary and artificial standards of social life, we may well shrink from the exposure involved in such tell-tale instruments. Yet if these plastic appliances bring with them even that outward cleansing of the cup and platter, represented by the purification of external life, their mission will not have been altogether in vain. On the whole, it is safe to conclude that Mr. Edison's position toward society as a benefactor or the reverse will be largely determined by the attitude of that august body toward itself.

Speculations in a somewhat lighter vein are admissible as to whether an indefinite augmentation of scent and sound is to be regarded in the light of an unmixed blessing. Perfumes are certainly in the minority here below, and evil smells in the ascendant; harsh sounds and clanging echoes sufficiently invade "the golden spaces of the silence," but if Mr. Edison will promise to waft spicy gales from the planet Venus, or recapture for our gross ears some faint echo of Pythagorean harmonies, we will promise not to impede the progress of his scientific Juggernaut by the interposition of our sublime persons.

Gathering into our remembrance the varied scope of these Edison miracles, we are dimly reminded of certain quaint records and fictional theories which seem to have held in solution the prophetic shadows of our present crystallizations. We are reminded of the enormous funnel constructed by Alexander the Great during his military campaigns for the purpose of heightening and projecting his tones to the most distant portion of his outlying forces; of the mystic sounds evoked from the statue of Memnon, and of the ingenious acoustic contrivances used in connection with Egyptian and Hellenic worship.

THE MEGAPHONE FOR LONG DISTANCE SPEAKING AND HEARING.

Among fictional works of a later date, we recall with peculiar pleasure a marvelous tale, dealing with the creations of a certain sage, in whose person the occult wisdom of the past blended happily with the progressive science of the present and future. Starting with the broad general assertion that "nothing is ever lost" in all the diverse operations of nature, he forms the minor deduction that every sound to which the teeming centuries have given birth since the opening chorale of the morning stars, is still coursing round and round the globe in ever remoter circles as the years pass on.

With a view to recapturing these nomadic strains, he constructed an instrument susceptible of adjustment in such a fashion as to overtake any desired melody in its proper chronological sequence. Every century or section of a century is represented by minute notches, so that it is only necessary to verify dates in order to feast your ears with the music peculiar to that epoch. This theory, as may be supposed, gives scope for many beautiful descriptive passages, foremost among which we recall a stirring picture of Miriam's "Song of Triumph," in its setting of resonant cymbals and swirl of Jordanic waves.

May this not have been a daring prefiguration of some of our nineteenth-century marvels? The time is past when we could apply the measuring rod of the past to the boundless possibilities of the future, and there is no reason why fancy should not revel in the brightening landscape which opens to her enchanted vision. What unsuspected arcana in the kingdom of sound are awaiting our restricted hearing, what delicate tintinabulations of fairy hammers, fashioning the shining facets of crystal and gem? What liquid monotones of falling water, shaping the cavernous architecture of stalactite and stalagmite? What soft stirrings in the mystic laboratories of Nature, what riotous coursings of impetuous sap? What symphonies of pent-up fires in the travailing bosom of the earth?

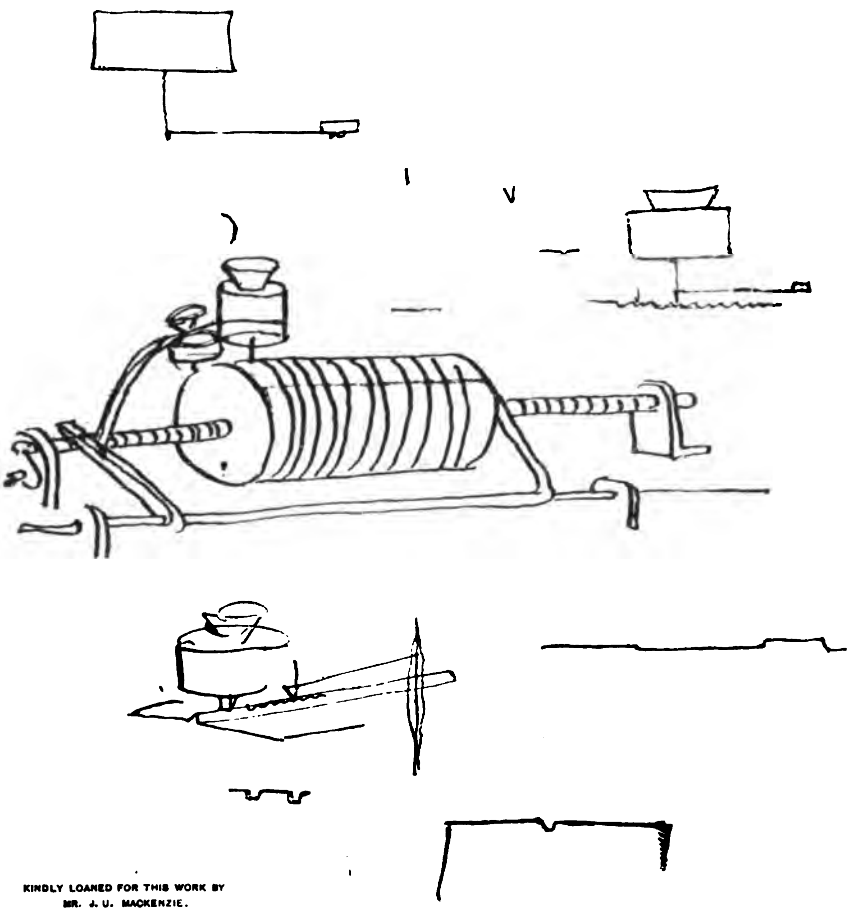
CHAPTER IX.

THE FIRST PHONOGRAPH, ITS SUBSEQUENT DEVELOPMENTS AND USES. TRANSMITTING PHONOGRAPH MESSAGES FROM NEW YORK TO LONDON. RECORDS OF EMINENT PERSONAGES AND WITCHING STRAINS.

THE discovery of the phonograph was based on one of those seeming accidents which enter so largely into the details of experimental science. At the same time, the minutiæ of a certain patent, taken out one year before the discovery of the phonograph, show the trend of his mind, and furnish an intelligent basis for the first rude germs of that marvelous invention. In this patent, Mr. Edison describes "a method of recording ordinary telegraphic signals, by a chisel-shaped stylus, indenting a sheet of paper, enveloping a cylinder or plate along the line of a groove cut in the surface of the latter." These indented marks were to be capable of re-transmitting the message automatically over another wire if required.

"I discovered the principle by the merest accident," states Mr. Edison. "I was singing to the mouth-piece of a telephone, when the vibrations of the voice sent the fine steel point into my finger. That set me to thinking. If I could record the actions of the point and send the point over the same surface afterward, I saw no reason why the thing would not talk. I tried the experiment first on a strip of telegraph paper, and found that the point made an alphabet. I shouted the words

'Halloo! Halloo!' into the mouth-piece, ran the paper back over the steel point, and heard a faint 'Halloo! Halloo!' in return. I determined to make a machine that would work



FIRST SKETCH OF THE PHONOGRAPH.

[From Edison's Original Drawing.]

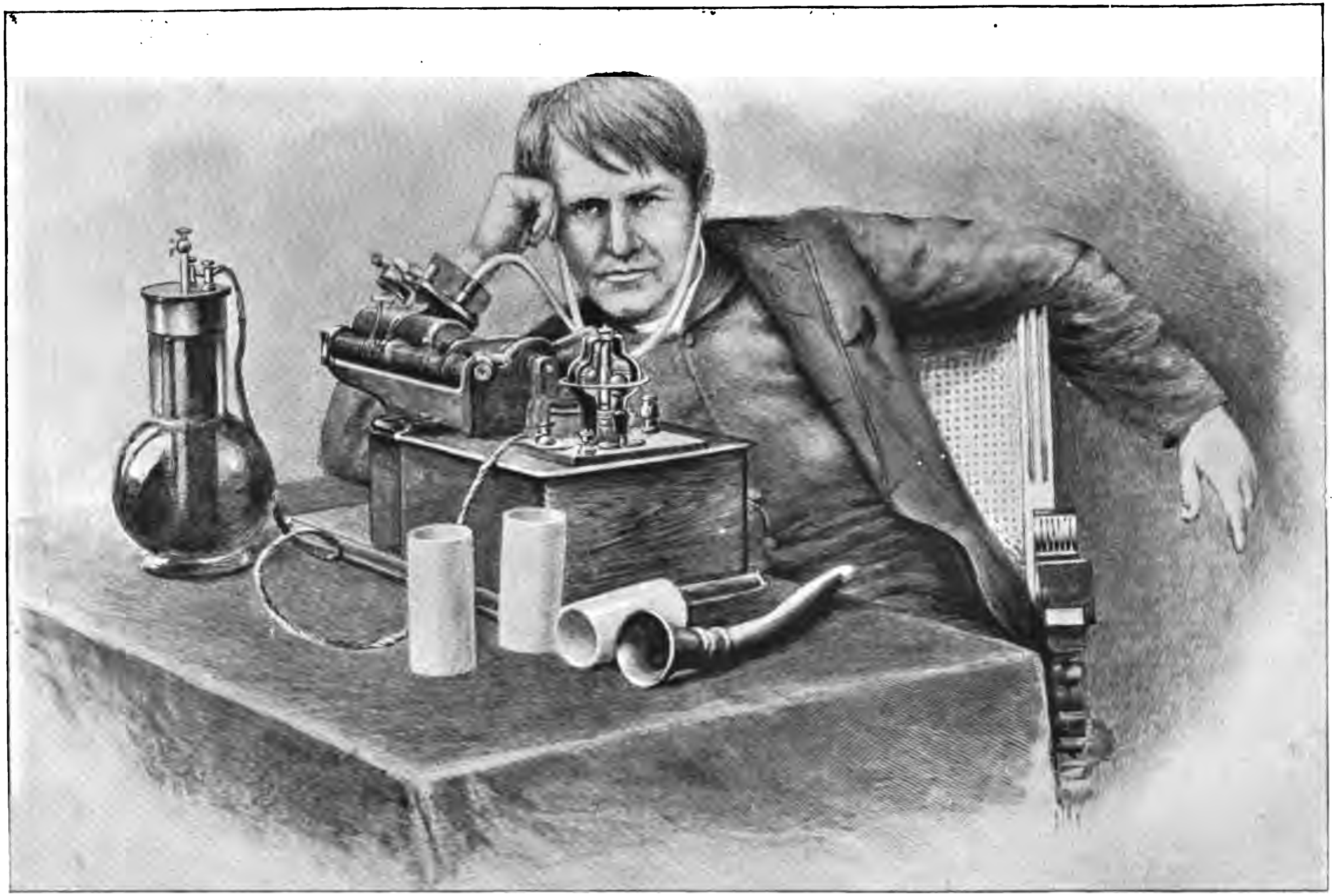
accurately, and gave my assistants instructions, telling them what I had discovered. They laughed at me. That's the whole story. The phonograph is the result of the pricking of a finger."

A further impetus was given to the idea by the chance suggestion of a noted magnate, the late General Butler, who, while examining the construction of one of Edison's telephones, was moved to remark: "Now, Edison, you must make something to record these sounds."

Shortly afterward, the inventor strolled into the Smithsonian Institute and embarked on a close scrutiny of the phonautograph, a machine used for the delineations of the sound waves, in connection with which he delivered himself of the following pregnant observation: "Wise men, these were, not to see that they could put a hard point and a piece of tinfoil in front of it, and there is the Phonograph."

The original tinfoil phonograph or talking machine, now on exhibition at the British Patent Office Museum, London, consisted of a metal drum, grooved throughout its whole width, with a fine spiral thread, over which a sheet of tinfoil was smoothed. The two ends of the foil were pressed together into a slot, cut across the drum. A needle, attached to a mica diaphragm, was made to rest on the tinfoil to receive the indentations, produced by speaking against the diaphragm. The drum was centred by a shaft, cut with the same thread and resting on suitable bearings, having two heavy fly-wheels at each end to give it uniformity of speed when turned by hand. Another needle and diaphragm were placed at the other side of the drum for repetition, the second needle following the indentation first made.

In the present perfected phonograph, driven either by water or electric motors, the drum and foil are replaced by a composition wax cylinder. The end of the recording needle is shaped like a gauge and scoops out fine particles of wax, while the shaft, traveling laterally over a spiral, composed of 200 threads to the inch, carries the needle along the surface. The extremity of the reproducing needle is shaped like a ball, and

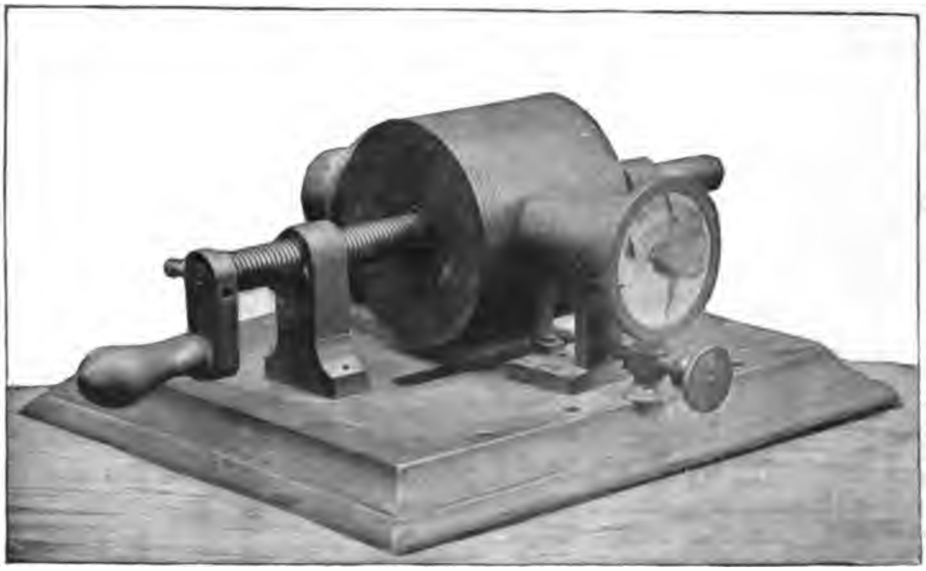


DRAWN BY R. F. OUTCALT — AFTER A PHOTO BY W. K. L. DICKSON

EDISON LISTENING TO THE PHONOGRAPH.

falls readily into the microscopical grooves, cut into the wax. The diaphragms to which these needles are attached are composed of very thin sheet glass. An all important feature of the present phonograph is the absolutely even pace attained by an automatic speed regulator. Every adjustment is now so greatly simplified that it requires practically very little skill, if any, in the manipulation of the machine.

The impressions made by the phonographic stylus are so marked in form and so logically dependent on the quality and quantity of the tones as to suggest the definition "visible speech." Mr. Edison holds that they are sufficiently legible and consistent to be read by experts, and the truth of his assertion has been partially verified by later investigators, prominent among whom were Professors Fleeming, Jenkin and M. Ewing, of the University of Glasgow, Scotland. The impressions secured were irregular, differing widely with the intonation of different people, the force employed and the rapidity of cylindrical rotation. Nevertheless, a certain basis of unity was established, which, under the eye of one exhaustively versed in the art, might be susceptible of reduction to practice. The consonantal forms are the deepest, resulting from the superior amount of explosive force requisite to produce them, an attribute which, curiously enough, the phonograph holds in common with the deeply furrowed characters of the ancient Runic, in which the consonant played an important part, to the exclusion of the vowels, so largely represented in the softer Latinic speech. As microscopically brought into view, in connection with the earlier sheet of tinfoil, the feminine members of the alphabet were less aggressive in their outlines than their masculine coadjutors, notwithstanding the fact that long *E* vindicated her rights to female enfranchisement by phonetic characters, bearing an alarming resemblance to a brace of Indian clubs. Some of the characters, however, notably those resulting



EDISON'S ORIGINAL TIN FOIL PHONOGRAPH.

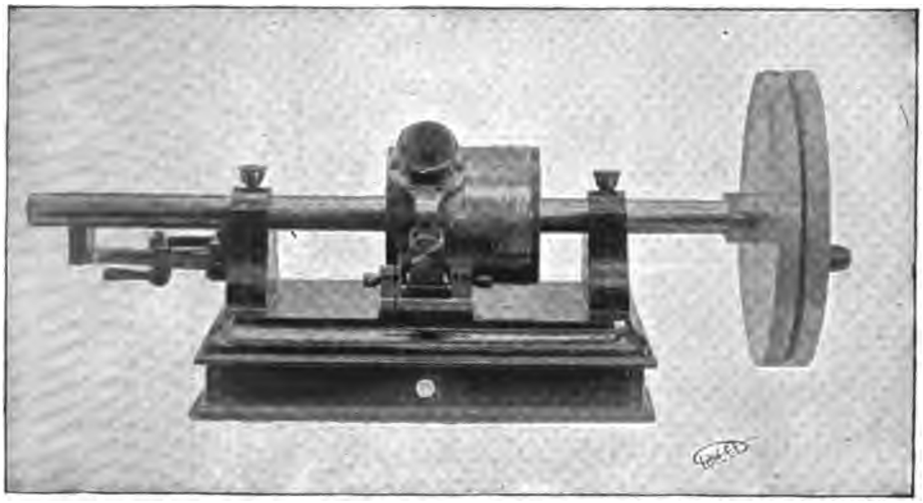
from attenuated vowel sounds, are outside of the range of microscopic power, being scarcely one millionth part of an inch in depth.

The finer shades of sound reproduction were not secured without extreme patience and repeated experiments. Aspirates and sibilants were always among the weak points of the phonograph, and Mr. Edison has frequently spent from fifteen to twenty hours daily for six or seven months on a stretch, dinning the word "Spezia," for instance, into the stubborn surface of the wax. "Spezia," roared the inventor—"Pezia" lisped the phonograph in tones of ladylike reserve, and so on through thousands of graded repetitions, until the desired results were attained. The primary education of the phonograph was comical in the extreme. To hear these grave and reverend signors, rich in years and scientific honors, patiently reiterating that

"Mary had a little lamb
A little lamb, *lamb*, LAMB."

and elaborating that point with an anxious gravity, hardly justified by the scale value of that unobtrusive animal—was to receive a practical demonstration of the "eternal unfitness of things."

The indefinite application of the phonograph to literary, musical, legal and commercial purposes opens up a vista of many-sided usefulness, such as few inventions are able to show, and entitles it to a place in future ages such as it is difficult to



ONE OF EDISON'S EARLY PHONOGRAPHS.

conceive will ever suffer displacement at the hands of progressive science. It is an indispensable adjunct in the concert room, the courts of justice, in business and newspaper offices, and in every phase of life where a swift and faithful record of sound is desired.

In 1878, Mr. Edison thus summed up the future applications of the new invention:

"Among the many uses to which the phonograph will be applied are the following: 1. Letter-writing and all kinds of

dictation without the aid of a stenographer. 2. Phonographic books, which would speak to blind people without effort on their part. 3. The teaching of elocution. 4. Reproduction of music. 5. The 'Family Record'—a registry of sayings, reminiscences,

EDISON AND HIS FIRST PHONOGRAPH IN 1878.

etc., by members of a family, in their own voices, and of the last words of dying persons. 6. Music boxes and toys. 7. Clocks that should announce in articulate speech the time for going home, going to meals, etc. 8. The preservation of languages, by exact reproduction of the manner of pronouncing. 9. Educational purposes; such as preserving the explanations made by a

teacher, so that the pupil can refer to them at any moment, and spelling or other lessons placed upon the phonograph for convenience in committing to memory. 10. Connection with the telephone, so as to make that invention an auxiliary in the transmission of permanent and invaluable records, instead of being the recipient of momentary and fleeting communications." Not only have these claims been more than substantiated, but each year brings with it a series of novel uses such as were undreamt of even by the inventor's far-reaching brain. Medical science has enlisted the phonograph into its service for the purpose of restoring lost hearing. Dr. George H. Leech, of Washington, D. C., one of the most noted specialists of our age, claims that this invention has been most successfully employed in stimulating the dormant or extinct functions of the ear, by means of the vibratory force conveyed from the cylinder of the phonograph to the diseased parts. This result is achieved by the production of a series of continuous, successive vibrations at regular intervals, the character, frequency and intensity of the vibrations being regulated according to the nature or severity of the case.

To the province of speech-reproduction, an amusing addition has been recently made. An expedition to South Africa has been actually formed for the purpose of immortalizing the language of apes, with a view to establishing the vexed question of animal intelligence. If the chatter and growl of these gifted brutes can be reduced to order and sequence, our insight into natural history will be immeasurably enlarged. The *New York Phonogram*, in a brilliant little article on the subject. recalls the human race to a sense of its filial obligations by suggesting that "If, as scientists have averred, we are descended from the Simian race, and the conductors of this expedition succeed in establishing communication with it, and discovering a new vocabulary, we shall owe to the phonograph the obligation of teaching us our mother tongue."

A dark outlook for comparative philologists, or rather for that class of learned men whose reputation is based on the deciphering of obsolete inscriptions. Beside the unfathomable antiquity of this tongue, the pretensions of such modern upstarts as Sanscrit, Egyptian, Etruscan or Aramaic, will fade into insignificance; and the erudition which secured them a fleeting immortality will take its place with the mushroom accomplishments of the day.

In its application to the varied requirements of commercial life, the phonograph is distinguished by extreme simplicity, so that no abnormal demands are made upon the harassed faculties of merchant or clerk. It is only necessary for the business man to talk into the receiver, in a natural tone of voice and at normal speed, after which the phonogram, as it is called, is received from the phonograph and enclosed in a little box, specially adapted for mail transportation. Cylinders of different sizes are prepared by the phonographic agencies, answering to our note, letter and foolscap paper, and embracing any number of words, from 500 and 800 to 4000. The recipient of the phonogram simply places it in his apparatus, and setting the machine in motion, is favored with his correspondent's views, not through the comparatively unsatisfactory medium of pen and ink, but in the familiar tones of articulate speech.

A series of interesting messages was thus transmitted by Colonel G. E. Gouraud, the agent for Mr. Edison's inventions in London, during the exhibition of the phonograph at the Crystal Palace, in 1888. The first phonogram, consisting of a private letter from Mr. Edison to his representative and containing about two hundred words, was received at Colonel Gouraud's house, Little Menlo, Beulah Hill, Upper Norwood, on the occasion of a festive gathering convened "to meet Mr. Edison," and when placed in the corresponding machine, the cylinder gave out such a startling reproduction of Mr. Edison's tones as to be

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LISTENING TO MESSAGES FROM EDISON (1888) IN ENGLAND.

at once recognized by every occupant of the room, not excepting some members of the rising generation, whose tender years absolved them from the charge of personal or scientific prejudice.

The following is an exact transcript of Mr. Edison's message on that occasion:

"AHEM! IN MY LABORATORY IN ORANGE, NEW JERSEY,
"June 16, 1888, 3 o'clock A. M.

"FRIEND GOURAUD,

"Ahem! This is my first mailing phonogram. It will go to you in the regular U. S. mail from New York via Southampton, North German Lloyd steamer Eider. I send you by Mr. Hamilton a new phonograph, the first one of the new model which has just left my hands.

"It has been put together very hurriedly, and is not finished, as you will see. I have sent you a quantity of experimental phonogram blanks, so that you can talk back to me. I will send you phonograms of talk and music by every mail leaving here, until we get on the best thing for the purpose of mailing.

"Mrs. Edison and the baby are doing well. The baby's articulation is quite loud enough, but a trifle indistinct; it can be improved, but is not bad for a first experiment. With kind regards,

"Yours, EDISON."

Preliminary to the musical and elocutionary features of the programme were the greetings of the phonograph itself, conveyed in prose and poetry. The first, addressed to the London Press, read thus:

PHONOGRAPH EXHIBITION AT CRYSTAL PALACE, LONDON, 1888.

"Gentlemen, In the name of Edison, to whose rare genius, incomparable patience, and indefatigable industry I owe my being, I greet you. I thank you for the honor you do me by your presence here to-day. My only regret is that my great master is not here to meet you in the flesh, as he is in the voice. But in his absence I should be failing in my duty, as well as in my pleasure, did I not take this, my first opportunity, to thank you and all the press of the great city of

London, both present and absent, for the generous and flattering reception with which my coming to the mother country has been heralded by you to the world."

The second, entitled "The Phonograph's Salutation," by the Rev. Horatio Nelson Powers, D. D., of Piermont on the Hudson, was couched in the following sonorous measures, prefaced by the words: "The contemplation of its wonderful character and performances is overwhelming, and my feelings naturally seek vent in verse. But the phonograph will speak for itself. Now listen to its voice:

"I seize the palpitating air, I hoard
Music and speech. All lips that breathe are mine,
I speak, the inviolable word,
Authenticates its origin and sign.

"I am a tomb, a paradise, a shrine;
An angel, prophet, slave, immortal friend;
My living records, in their native tone,
Convict the knave, and disputations end.

"In me are souls embalmed. I am an ear,
Flawless as truth, and truth's own tongue am I.
I am a resurrection; men may hear
The quick and dead converse, as I reply.

"Hail! English shores, and homes, and marts of peace,
New trophies, Gouraud, yet are to be won.
May 'sweetness, light,' and brotherhood increase;
I am the latest born of Edison."

After some musical selections, chosen for their wide diversity of tone, and ranging from the delicate gossamers of a whistled operatic aria to the broad sonority of a cornet and piano duet, the various distinguished guests gathered around the magical instrument and availed themselves of Mr. Edison's amiable permission to "talk back." The combined

result of these conversational efforts reached the inventor early in January, 1889, and were contained in a small oaken box about a foot long. The consignment embraced cylinders from Gladstone, Sir Morell Mackenzie, James Knowlton, editor of the *Nineteenth Century;* the Earl of Aberdeen, the Earl of Meath, Lord Rowton, a distant relative of Beaconsfield; Sir John Fowler, the builder of the Scottish bridge; Sir William Hunter and Sir Rowland Prothero.

Sir Morell indulges in the hope that he may be privileged to meet the inventor in the near future; other luminaries send messages of cordial appreciation and friendship, and Gladstone conveys his sentiments in the following characteristic fashion: "I am profoundly indebted to you for, not the entertainment only, but the instruction and the marvels of one of the most remarkable evenings which it has been my privilege to enjoy. Your great country is leading the way in the important work of invention. Heartily do we wish it well; and to you, as one of its greatest celebrities, allow me to offer my hearty good wishes and earnest prayers that you may long live to witness its triumphs in all that appertains to the well-being of mankind."

HUMAN VOICE RECORDS.

The above phonogram was sent in compliance with Mr. Edison's request, conveyed in a letter to his partner. The inventor's wishes on this subject filtered out, as such things have an occult way of doing, and elicited an inspired stanza from the London *Globe*, of which a reprint is given on the page opposite.

EDISON TO GOURAUD.

"SEND ME MR. GLADSTONE'S VOICE."

Send the secret, send it on,
To the land of Washington;
Ere the profit others make,
Send it me for Humbug's sake.
All the electric box of tricks,
How to split a hair in six;
How to patch a tattered lie,
Facts forget and deeds deny—
Send me, agent of my choice,
"Send me Mr. Gladstone's voice!"

By those accents which surpass
E'en the best of Yankee brass;
By those words which seeming plain,
Film with fog the brightest brain;
By the stone on Blarney's hill,
By the ghost of Mandeville,
By distinctions, false and fine,
By humanely cropt-tailed kine,
Bid my balance-sheet rejoice—
"Send me Mr. Gladstone's voice."

From time to time contributions of equal value were made to phonographic lore on both sides of the Atlantic. Queen Victoria sent a message to the inventor, couched in the most benign terms; Henry Irving and other histrionic lights added their quota of approval; golden-toned singers and instrumentalists embalmed their genius for his benefit, but the most superb results were achieved during the Handel Festival of 1888. A gigantic horn, placed in the press gallery of the Crystal Palace concert-room, gathered up the majestic harmonies of the composer, in the several vocal and instrumental settings. Four thousand voices, a thunderous organ and a mammoth

orchestra combined in the exposition of Handel's "Israel in Egypt," and this Titanic volume of sound, with its finer contrasts of light and shade, was reproduced by the phonograph in a manner little short of the miraculous. These priceless records were duly dispatched to Mr. Edison, and exhibited before large audiences in the principal American cities.

CHAPTER X.

SOME FANCIFUL USES OF PHONOGRAPH. COMMERCIAL ACTIVITY OF INVENTION. PHONOGRAPHIC INDUSTRIES. THE ORANGE PHONOGRAPH WORKS. THE PHONOGRAPH AT THE PARIS EXPOSITION OF 1889. IN KINGS' PALACES AND AMONG THE PRINCES OF THOUGHT.

PERHAPS the daintiest and most suggestive of all the multiform uses to which the phonograph has been put is in connection with the kingdom of toys. The last touch of reality has been imparted to the wondrous wax creations which foster the maternal element in childish hearts by the introduction of vocal tones. Roseate lips lisp out the oft-conned syllables of nursery rhymes, pipe the familiar strains of Mother Goose's ballads, and give forth the cooing and wailing sounds of baby life; a tiny phonograph, concealed in the recesses of the doll, is the motive power of these magical effects. Under such auspices, into what an enchanted realm will our ordinary toys be transformed; the inmates of Noah's ark, from stiff, mechanical puppets, will become miniature Barnum menageries, enlivened by the crowing, neighing, mewing and growling peculiar to the animals represented. The mimic theatres will rejoice in a duodecimo edition of the typical showman, giving his attenuated announcements from pigmy lungs, and within the fairy precincts, a band of Lilliputian actors will delight their baby audiences by life-like presentments of elfin lore.

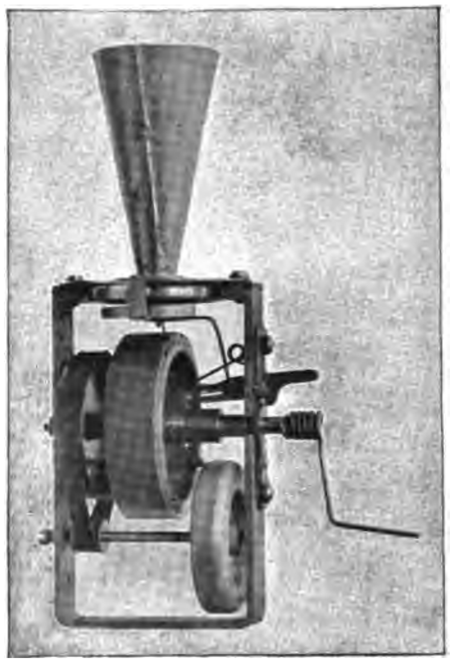
The first trio of these gifted Lilliputians was presented to the Queen of Holland for the benefit of the royal nursery, whose

joyful antics on that occasion gave evidence of the "touch of nature which makes the whole world kin." In this enumeration may also be mentioned the application of the phonograph to clocks, a field which opens up an illimitable scope of effects, humorous, hortatory, and weird. A recent guest of Mr. Edison was startled from sleep just at that witching hour "when churchyards yawn and graves give up their dead" by the following awful injunction: "Midnight has struck! Prepare to meet thy God." The tones were hollow and resonant, and filled the spacious room with weird echoes, but the source of this intimidating remark was nowhere to be seen. Believing himself to be in possession of a valuable contribution to the annals of psychical research, but unwilling, even in the interests of that learned body, to pursue his investigations, the visitor fled incontinently from the chamber into the passage, where, fortunately for the preservation of his remaining wits, he was met by Edison himself, and reassured in the following words: "Don't be scared, old man, it's nothing but a clock."

PHONOGRAPH APPARATUS FOR DOLLS.

The increasing demand for these perfected playthings gave birth to the Edison Phonograph Toy Company, incorporated toward the close of 1887, and capitalized for $600,000, of which $400,000 was issued for patents and franchises. It was esti-

mated at the time that the world's yearly demand for high-priced dolls alone was at least $700,000, and the popular appetite has since been whetted rather than allayed by familiarity with phonographic embellishments. Shortly after the foundation of this company, orders to the amount of $200,000 were received in this country alone, $80,000 emanating from the Pacific Coast trade, $200,000 were put on sale at the Paris Exposition, and cash offers ranging from $165,000 to $350,000 for the exclusive right of European sales, poured in upon the inventor. Factories were established in Europe for the construction of the dolls' bodies, and these being forwarded to the phonographic works at Orange, N. J., were equipped with the necessary vocal apparatus, $3000 per day being the average achieved in 1889.



TALKING DOLL MECHANISM.

The phonograph, from a commercial standpoint, has shown remarkable signs of virility. In 1878, a company was formed, with a capital of $600,000 and having for stockholders the following influential men: Gardner C. Hubbard, G. L. Broadley, of Cambridge, Mass.; Charles A. Cheever, Hilborne L. Roosevelt, of New York; N. H. Painter of Washington, D. C.; E. H. Johnson and T. A. Edison. The company, after organization, paid Edison a royalty of $10,000 as a guarantee of good faith, and agreed further to pay him twenty per cent. on gross receipts from all sources.

The Microscopic Company of London outstripped its numerous competitors in securing the use of the phonograph on British soil, and acquired that privilege for the sum of £1500 sterling, as a guarantee of good faith, in advance of a stipulated royalty. Mr. Edison's interests were similarly protected in Russia and France and other European countries, and an unusually solid pecuniary basis supported the fabric of international approval.

To-day the phonographic industries are represented by agencies in thirty-four States and Territories, and the central focusing point of supply, the North American Phonograph Company's headquarters in New York, ranks among the most stately and complete offices in the great metropolis, while the Edison Phonograph Works, of Orange, N. J., located conveniently near Edison's laboratory, but operating under independent auspices, are marvels of concentrated energy.

These consist of four large buildings, each about 350 feet long. The main building or machine shop presents an immense vista of these appliances, such as drilling and cutting machines, planers, lathes, etc., all utilized in the construction of the 418 parts, which this complicated, yet simple appearing, apparatus involves. The operations of japanning, polishing, nickel-plating, etc., are performed in specially assigned departments, after which the various sections are carried to the assembling room, carefully examined, put together and placed in the stockroom, preparatory to packing and shipment, the latter work being greatly facilitated by the position of the Erie Railroad, which runs a branch of its cars directly to the door. In the sapphire department, probably the most interesting feature of the establishment, is found the perfected results of Mr. Edison's researches for materials in connection with the recorder stylus, turning-off knife and reproducer ball, all essential elements in the recording and reproducing parts of the speaking mechanism. The operations of shaping, grinding and polishing the rough stone

PHOTO BY W. K. L. DICKSON.

PHONOGRAPH ROOM IN EDISON'S LABORATORY AT ORANGE.

are attended with extreme difficulty, and necessitate conscientiousness and expert skill. The sapphire is first sawed into thin slices, one twentieth of an inch in thickness, then into cube pieces. In the production of the recorder stylus and reproducer ball it goes through an additional process of concentration and grinding, receiving its final polish through the medium of

SOMETHING FUNNY.

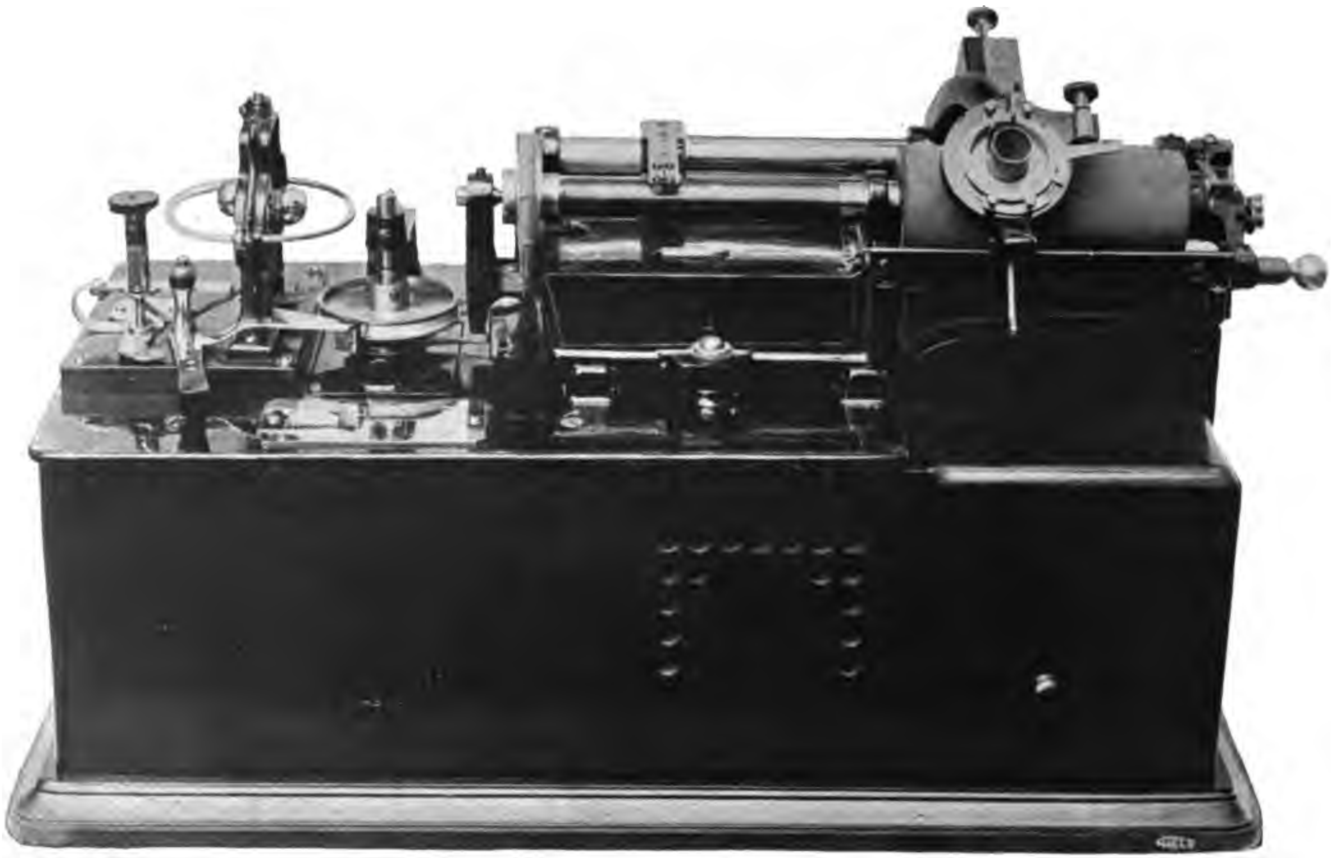
very fine diamond powder, supplied through a wooden or shell cap. The operation is so exacting as to necessitate not only the most delicate manipulation, but the enlarging power of a strong microscope. Of extreme difficulty also is the formation of the reproducer ball, the primary shaping of which is done by a diamond tool, after which a special machine gives it the required spherical outline. This when completed is twenty-five thousandths of an inch in diameter. The cylinder upon which

any record has been made may be again and again utilized. In fact the depth of the impression made by the human voice or a full brass band is so slight that thirty or forty records may be successively placed on the wax cylinders. For this purpose to each phonograph is attached what is called a turning-off knife. In the preparation of these turning-off knives, about sixty pieces are secured by cement to one block, and the flat sides polished and ground, the final polish being imparted by machinery, which secures the required keenness of edge.

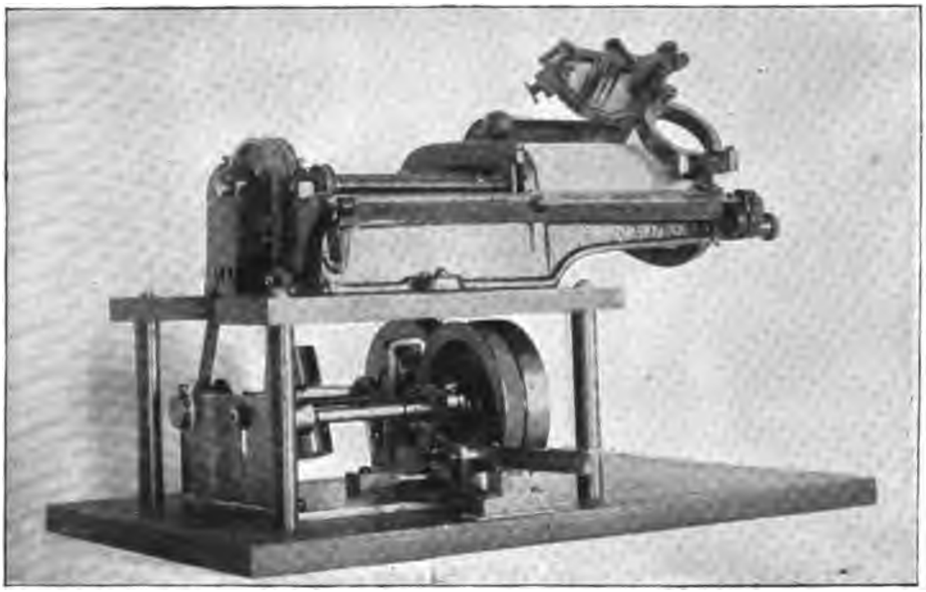
In the cylinder department an inquisitorial secrecy prevails, and the component properties of the wax are locked in the bosom of one trusty familiar. Four weeks are required for the molding and seasoning of these cylinders, after which they are prepared for shipment.

Mr. Edison has perfected a method for the multiplication of records—an important point where the golden tones of a Patti are in question—but as the minutiæ of these operations are held under the Rose, we will not touch on them further than to say that the cost of reproduction is trifling, and the process easy and rapid. To secure the first record is a matter necessitating expert skill, but once secured, an indefinite number of *fac-similes* may be obtained from the original cylinder. In fact, no experiments have succeeded in establishing the limits of this reproductive power. Its durability is something marvelous. Time seems to have no effect in injuring its component properties. Legal deeds may therefore be safely incarcerated during a period of possibly a hundred years, and disinterred whenevei the majestic deliberation of the law sees fit to require their presence.

The phonograph, in its several stages of development, for no child of Edison's brain has ever received such fostering care, has been the focusing point of interest in every exhibition which has taken place since 1878, and it has been the



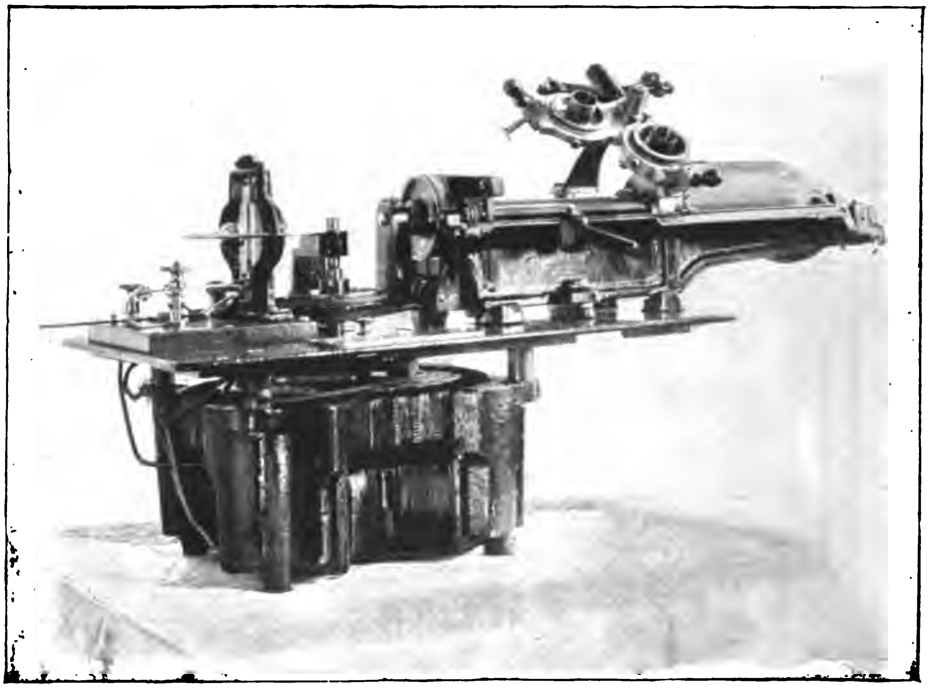
THE PERFECTED PHONOGRAPH.



PHONOGRAPH OPERATED BY HAND.

recipient of eulogistic notices, sufficient to disturb the equilibrium of even so well balanced and precocious an infant. No medals have been directly awarded to the phonograph, simply because there has been no competition on that score, but the majority of the distinctions conferred upon Mr. Edison have been called forth by this unique production of his genius. In the French Exposition of 1889, the perfected phonograph furnished a pacific meeting-ground for the most antagonistic types, and no nationality, from the impassive Turk to the excitable Gaul, could resist the temptation of hearing its tones reproduced. "Never before was such a collection of the languages of the whole world made. It was the first linguistic concourse since Babel times."

Mr. W. J. Hammer, who was in charge of the phonograph department at the Exhibition, estimates the daily concourse of people attracted by that instrument alone at 30,000. Forty-five phonographs were used, most of them being shown in the



PHONOGRAPH AND ELECTRIC MOTOR.
(Inside View.)

machine gallery, where the major part of Mr. Edison's display was situated, and the balance in the special phonograph pavilion, constructed at great expense in the industrial section. The public was afforded every facility for the registration of tone, and an endless variety of effects was secured, including a faithful reproduction of the Eiffel cannon, and embracing contributions from the most distinguished electricians, musicians and statesmen of Europe. Among the visitors present were the late President Carnot and his family, Mr. and Mrs. Gladstone, the Prince and Princess of Wales, the Prince of Monaco, Buffalo Bill and suite and De Brazza, the famous African explorer. De Brazza brought with him about fifteen representatives of different African tribes, all of whose various inflexions of sounds were carefully embalmed. The explorer showed deep interest in

the phonograph, and looked hopefully to the time when that instrument would serve an important use in South Africa. Four or five of the tribes represented had no written alphabet, and the various trading companies and governments who

A PHONOGRAPH DRIVEN BY WATER POWER.

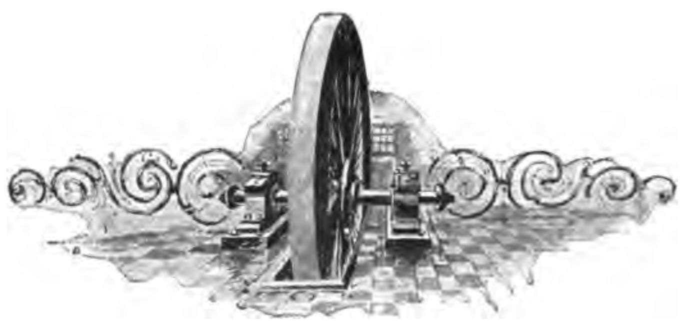
desired to make contracts with the natives were at their wits' ends to discover methods of recording these treaties. By means of the phonograph, an official record could be made of the conversations, and a wholesome check imposed on the slippery imagination of the contractors.

Among the triumphs achieved by the phonograph may be reckoned the utter annihilation of Indian composure. One of the Sioux braves, composing the suite of Buffalo Bill, was requested to step forward and speak into the phonograph, which he did, with no relaxation of his constitutional dignity, but the matter was otherwise when the garnered accents found their way back to the auditory nerves of Red Shirt, the famous chief. On hearing the familiar gutturals, he became terrified, threw the tubes down and jumped backward several paces, his face and manner indicating the greatest alarm, nor could he be prevailed upon to again approach the instrument, insisting that he had heard the voice of the Great Spirit. After this mysterious manifestation of power, the Indians would not come nearer than fifteen or twenty feet of the phonograph, and seemed to regard it with a superstitious awe.

From public exhibitions to the palaces of kings and the homes of the great world shapers, was a swift and easy transition. In 1890 the phonograph, then in charge of Mr. A. Theodore E. Wangeman, visited the Berlin Court, at the cordial request of the Kaiser, and was listened to with intelligent appreciation by the members of the Imperial household. The Emperor showed extraordinary mechanical skill on this occasion, reconstructing the phonograph after its disintegration, and giving a lucid explanation of its component parts. Records of the three young princes were secured, in the shape of speech and song, and a touching resemblance was detected between the voice of dead Emperor Frederic and that of little Prince Frederic.

The Tsar, then visiting Berlin, desired an introduction to the phonograph, and was moved from his usual impassive calm to speak most appreciatively of the inventor and his achievements. The Emperor Francis Joseph, Prince Ferdinand of Bulgaria, Princess Charlotte of Prussia, and the Duke of Saxe

Meiningen, the two Bismarcks and Von Moltke were numbered among the auditors of the phonograph, and the public enthusiasm became so great that, at Buda Pesth alone, 15,000 persons sought admission at one time. Many novel possibilities were suggested for the invention by the leading minds of Europe, Count Herbert Bismarck proposing that concealed phonographs should be used to record the proceedings of diplomatic conferences. Bismarck the elder thought the phonograph "a dangerous thing for diplomats, and also a good thing, as they would be forced to tell the truth."

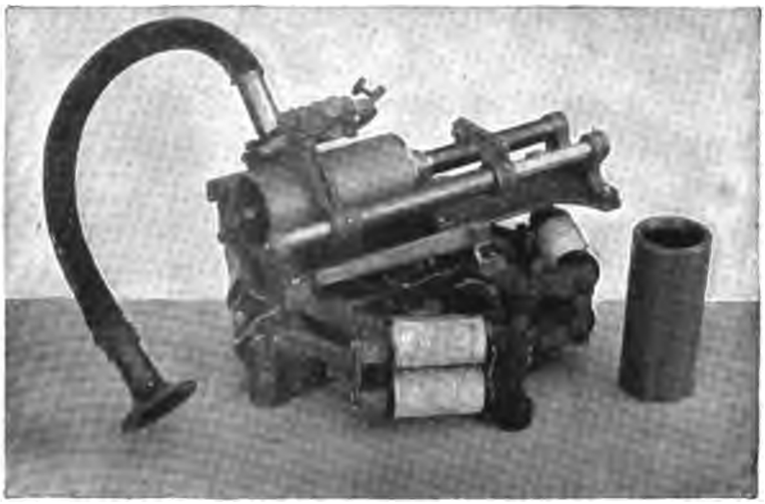


CHAPTER XI.

HISTORICAL AND FICTIONAL FORECASTS OF THE PHONOGRAPH.

OF all the wonders born of Edison's prolific mind, the phonograph appealed most strongly to the imaginative faculties of the public. The daily periodicals competed with each other in poetical rhapsodies, in comic forecasts of its possibilities. Every conceivable vein of pathos, of humor, of speculative fancy, concealed within the vast mines of human thought and feeling, were ardently exploited, and often by no unskillful hands. Antiquarians instituted cunning comparisons between the rude and shadowy theories of the ancients and the symmetrical crystallizations of the nineteenth century. Students were pointed to the descriptions given in Goodwin's edition of Plutarch's Morals, viz., in the quaint essay, "How a man may be sensible of his progress in Virtue." "This Antiphanes said merrily, that in a certain city the cold was so intense that words were congealed as soon as spoken, but after some time they thawed and became audible, so that the words spoken in winter were articulated next summer. Even so the many excellent precepts of Plato, which he instilled into the tender ears of his scholars, were scarce perceived and distinguished by many of them till they grew to be men and attained the warm, vigorous summer of their days." The suspicious resemblance to Baron Münchausen's amazing adventure was drawn for the benefit of students in comparative mythology.

Rudolphe Erich Raspe, a literary aspirant of indomitable if erratic ability, writing in the character of his military hero, Baron Von Münchausen, takes occasion to say, in the relation of certain Siberian adventures: "I traveled post, and finding myself in a narrow lane, bid the postilion give a signal with his horn, that other travelers might not meet us in the narrow passage.



EARLY PHONOGRAPH WITH ELECTRIC MOTOR.

"He blew with all his might, but his endeavors were in vain; he could not make the horn sound, which was unaccountable and rather unfortunate. . . . After we arrived at the inn my postilion and I refreshed ourselves; he hung his horn on a peg near the kitchen fire; I sat on the other side. Suddenly we heard a *tereng! tereng! teng! teng!* We looked round and now found the reason why the postilion had not been able to sound his horn; his tunes were frozen up in the horn, and came out now by thawing, plain enough, and much to the credit of the driver; so that the honest fellow enter-

tained us for some time with a variety of tunes, without putting his mouth to the horn -The King of Prussia's March—Over the Hill and over the Dale, and many other favorite tunes; at length the thawing entertainment concluded, as I shall this short account of my Russian travels."

Aristotle's significant reference to Homer's words will be remembered, in which he declares these to be "moving, flying and consequently animated." The following quaint description, from the pen of that "Comic Homer," François Rabelais, born in the last quarter of the fifteenth century, is spiced with a certain antique flavor. Among the few edible portions of that unsavory Olla Podrida, occurs the following ingenious account of a voyage, during which the discoverers "were mightily frightened by various sounds and voices of men, women, children, horses, etc.," floating apparently in the air withou any visible corporeal basis:

"Be not afraid, my lord," the skipper makes answer, "we are on the confines of the Frozen Sea, on which, about the beginning of last winter, happened a great and bloody fight between the Arismapians and the Nephelibates. Then the words and cries of men and women, the hacking, slashing and hewing of battle axes, the shocking, knocking and jolting of armors and harnesses, froze in the air, and now the rigor of the winter being over, by the succeeding serenity and warmth of the weather, they melt and are heard."

The author indulges in many other old and merry conceits in the course of his tale. Among the unfrozen words, yielding their burden of sweetness or unsavoriness to the balmy air, were some of so hard a nature as to be impervious to softer influences. Such were certain heraldic terms. Vert, azure and black, which, being warmed in the hand, melted like snow, giving forth sounds like gibberish. Shade of *Toison d'or*, what a definition of the noble science of heraldry!

Other frozen commodities, in which lay concealed the

quintessence of murderous thoughts, blasphemy and uncleanliness, being cast into the fire, not only produced sharp and alarming reports, but had an unpleasant trick of recoiling on the heads of those who tampered with them, inflicting many "a slit weesand" and other grim and ghastly wounds. As an offset to these undesirable commodities were some "merry, odd words, the which," remarks the author, with quaint regret, "I would fain have preserved in oil, as ice and snow are kept, and between clean straw." Could the princely giant have floated down the stream of time to the harbors of that enchanted country, the nineteenth century, he would have found his aspirations realized in the phonograph.

From that strange land of unfathomable antiquity which claims to have been the birthplace of gunpowder, printing, the mariner's compass, cantilever bridges, etc., and the hoary wisdom of whose past contrasts so amusingly with the stultified idiocy of its present, comes the following suggestive tale:

A certain woman of the Flowery Kingdom united to physical loveliness a voice so inexpressibly beautiful, that its echoes stirred the soul strangely, and moved to deeds of love and valor. As years passed on, the beauty of this fair woman became more and more perfect, as all human loveliness must needs, fed on the flame of divine purity and strength. Also the tones of her voice gained in vibrant tenderness, so that her children thought with sorrow of the days in which those accents would be stilled by the icy touch of death. They therefore took counsel with a wise woman who gave them a bamboo cane, endowed with certain magical properties. Into this the beautiful mother spoke, after which the cane was carefully sealed and put away for many years. When several generations had succeeded each other, the ancient legend of this wise and gentle ancestress was revived, and the cane brought from its place. On being opened, the golden accents of the fair woman fell upon the air,

freighted with all their pristine sweetness and power. Breathlessly the people listened, and as the last echo died away, they broke into sorrowful lamentations, for alas, the tones of that wonderful voice might never be repeated.

Of later date in the line of predictions is the curious reference in Jean Ingelow's fairy tale "Nineteen Hundred and Seventy-two," first published in 1872.

"He" (the hero) "began to describe what was evidently some great invention in acoustics, which, he said (confusing his century with mine), you are going to find out very shortly. . . 'You know something of the beginnings of photography?' I replied that I did. 'Photography,' he remarked, 'presents a visible image; cannot you imagine something analagous to it which might present an audible image? The difference is really that the whole of a photograph is always present to the eye, but the acoustigraph only in successive portions. The song was sung, and the symphony played at first, and it recorded them, and gave them out in one simultaneous, horrible crash; then, when we had once got them fixed, science soon managed, as it were, to sketch the image—and now we can elongate it as much as we please.' 'This is very queer!' I exclaimed. 'Do you mean to tell me these notes and these voices are only the ghosts of sounds?' 'Not in any other sense,' he answered, 'than you might call a photograph the ghost of sight.'"

Miss Amelia B. Edwards is also credited with an ingenious forecast of phonographic principles, and in Hood's comic annual for 1839 is found the following prophetic passage:

"In this century of inventions, when a self-acting, drawing paper has been discovered for copying invisible objects, who knows but that a future Niepce, or Daguerre, or Herschel, or Fox Talbott, may find out some sort of Boswellish writing paper to repeat whatever it hears?"

The inventor himself has joined the ranks of prophets, with

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Thomas A. Edison.

results infinitely creditable to his powers of prediction. In those dim days when the phonograph was little more than a spectral possibility, based on the crudest of material foundations, Mr. Edison wrote: "This tongueless, toothless instrument, without larynx or pharynx, dumb, voiceless matter, nevertheless mimics your tones, speaks with your voice, utters your words, and centuries after you have crumbled into dust, will repeat again and again to a generation that could never know you, every idle thought, every fond fancy, every vain word that you choose to whisper against this thin iron diaphragm. I think the world is on the eve of grand and immense discoveries, before whose transcendent glories the record of the past will fade into insignificance."

No prophecy ever received a more minute realization. The phonograph of to day, in the tenacity of its retentive powers, and in the fidelity of its reproduction leaves absolutely nothing to be desired. Day by day adds to the imperishable records of music and speech. All the burning thoughts of poet and sage, all the liquid beauty, mellowness and vibrant sonority, all the ineffable pain and ecstasy of earth's inspired singers, all the passion and thrill, the subtle coloring of stringed and keyed instruments are being rescued from the gnawing tooth of time and crystallized within tiny cylinders of wax. At last, in the fullest sense of the term, can we be said to be heirs of all the ages. At last, the misty, the erroneous and unsubstantial traditions of the past have given place to the vital and sonorous records of the present. Yet so formed are we, so keen is the edge of pain in all our fancied delights, that we sometimes are led to doubt whether it is altogether well to resign ourselves into the keeping of "deep-eyed Mnemosyne."

"There is a pleasure which is born of pain:
  The grave of all things hath its violet,
Else why, through days which never come again,
  Roams Hope, with that strange longing, like Regret.

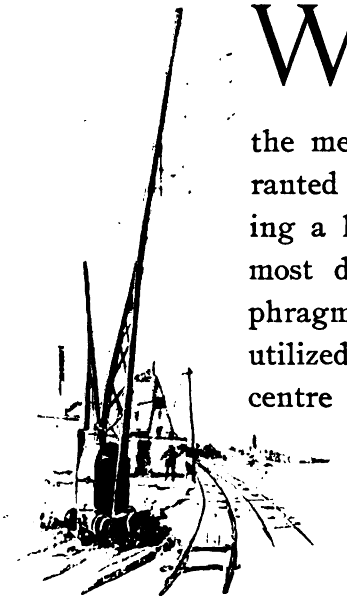
Why put the posy in the cold, dead hand?
 Why plant the rose above the lonely grave?
Why bring the corpse across the salt sea wave?
 Why deem the dead more near in native land?"

* * * * * *

Is it well to call up from that dim place of graves "the touch of a vanished hand, the sound of a voice that is still?" Shall not the dead be free to bury their dead? How else shall Time accomplish his perfect work if that tender messenger, Oblivion, may not lay his velvet touch on straining eyes and bursting heart? Are there no draughts of nepenthe, no streams of forgetfulness under the new régime, and is there sooth in the saying that "Lethe flows not through the Christian's Paradise?" Ah! me, the pity of it, the pain of it! Yet again—for the mind has many facets, which lend themselves to the reflection of many-colored thoughts—may there not be a tenderer, a wiser, a more comforting solution to the sorrowful enigma? Are we to be taught that the new, the sweet, the wholesome sunlight of this enlightened age has power to shine even into these moldy treasure-houses of ours, to arrest the decay and to unmask these poor, shivering spectres who are tricking us in the guise of our redeemed? Are we to learn that death, that livid horror of the infant centuries, is simply an orderly step in life's progression, the stripping of a useless and cumbersome husk, preparatory to the full assumption of that larger freedom, that quickened thought and ripened energy which await us in that fair "Haven where we would be?"

CHAPTER XII.

THE PHONOMOTOR. NEW FORMS OF TELEGRAPHY. TELEGRAPHING FROM A MOVING TRAIN. THE PHONOPLEX TELEGRAPH. TELEPHONY. PYRO-MAGNETIC MOTOR AND GENERATOR. MAGNETIC BRIDGE.



WITHIN the line of thought suggested by the phonograph, came the phonomotor, an instrument for measuring the mechanical force of sound waves, and warranted to accomplish the occult feat of "talking a hole through a board," a consummation most devoutly *not* to be desired. The diaphragm and mouth-piece are similar to those utilized in the phonograph, and secured to the centre of these is a brass rod carrying a steel pawl, the latter actuating a ratchet wheel, furnished with a series of very sharp teeth, mounted on a delicately centred shaft with flywheel attached, and impelling forward a colored disc, by means of a belt. The flywheel is swift to catch the infection of the sounds communicated to the diaphragm by the tones of the human voice, and responds to the call with a velocity which is amazing. If sounds involving any degree of continuity are employed, the flywheel revolves with such speed as to necessitate considerable force in bringing it to a standstill. A new field is opened up for those "sophistical rhetoricians, inebriated with the exuberance of their own verbosity," to whom garrulity is as the very breath of life. As shown in the illustration, the seamstress may exercise her vocal powers instead of the treadle,

the tirades of a virago may find expression in a pile of neatly sliced kindling, while the nineteenthlies of her reverend spouse may receive ultimation in the sawing of substantial logs. Thus shall the law of compensation be made good, and the clouds of suffering, induced by strident tones, be lined with the argent of domestic economy.

From this fruitful source of discord, human speech, we pass in orderly sequence to one of Edison's inventions, a strange field of thought for a mind devoted so exclusively to the promotion of placid industries. This is none other than the Edison-Simms torpedo, a formidable engine of destruction, consisting of a submarine torpedo boat, propelled by electricity. The torpedo proper furnishes an encasement for the explosive charge and the electrical motor, and being lowered several feet under water in a float, is controlled from a neighboring ship, or from the shore by means of an electric cable, through the medium of which all currents for the regulation of speed and direction are transmitted.

Faster and faster, as the years flew on, came the marvelous inventions. Thick as owls in Athenian temples, they crowd about us, supplying an emphatic denial to those moldy aphorisms which deal with the impossibility of heating more irons than one, and which cast such serious imputations on the trading abilities of our nursery friend, James.

The prolific field of telegraphy yielded new and perfected forms with every succeeding month.

The Harmonic Multiplex Telegraph was devised, consisting of a number of tuning forks or reeds, of varying size or pitch, placed at each end of the line, in exactly corresponding pairs, each one independently energized by electro-magnets, the reeds becoming both key and sounder. Each receiving reed or tuning fork responds harmonically only to its own pitch or number of vibrations per second, so that a large number of reeds can be

TELEGRAPHING FROM A PULLMAN PARLOR CAR ON TRAIN IN MOTION.

EDISON'S PHONO-MOTOR OPERATING A SEWING MACHINE.
[A Suggestion.]

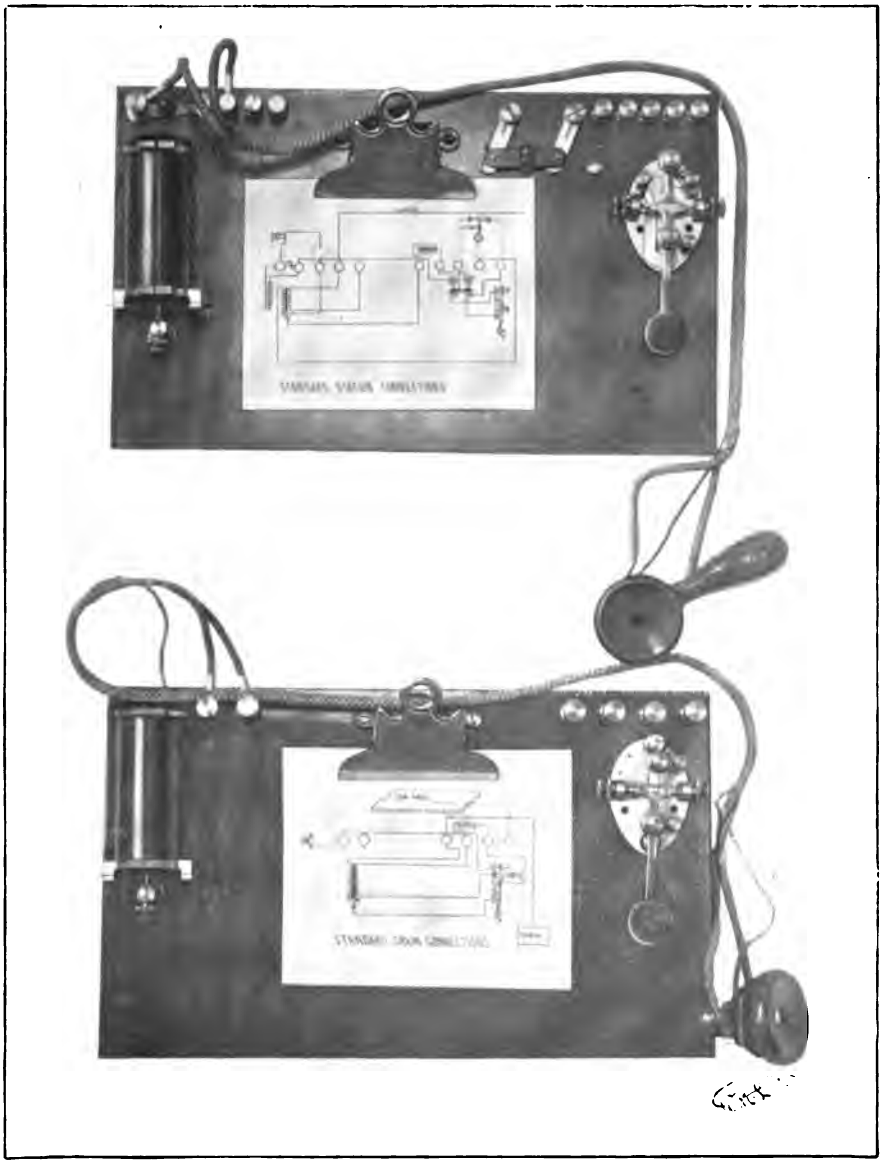
used, or messages sent over a single wire through the medium of the ordinary Morse code, without necessarily interfering with each other. Mr. Edison has sent as many as sixteen messages at a time, or eight each way.

Perhaps one of the most interesting of these devices is that known as: "Telegraphing from a moving train." In this ingenious application no extra wire is utilized, and the viewless air alone officiates as a medium in the transference of the electrical currents from the train apparatus to the ordinary telegraph wires running alongside the track. Induction, or that wonderful property of the science by which electricity may be developed

in a substance by the influence of neighboiing electricity, is the underlying force employed, and explains the fact that the currents induced are enabled to circulate without the smallest hindrance to their legitimate uses. An ordinary battery, a couple of telephone receivers, an induction coil with vibrator, and a Morse key, constitute the details of the apparatus. The

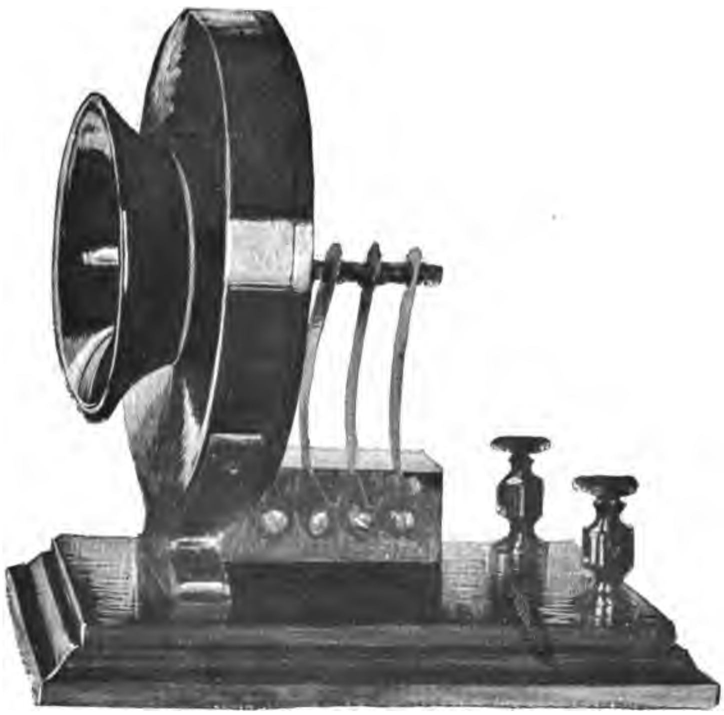
EDISON'S PHONOPLEX SYSTEM OF TELEGRAPHY.

induction coil transmutes the current from the battery into one of swiftest alternating properties, which produces a like current in neighboring wires. The humming sound called forth is changed, through the medium of the key, into the familiar dots and dashes of the Morse system. The roofs of the cars are rendered available by the attachment of wires, connected with each other and with the instruments, which in their turn are linked with Mother Earth, through the car wheels and track. The workings of the system have been so feasible and inexpen-



INSTRUMENTS FOR TELEGRAPHING FROM MOVING TRAINS.

sive that train telegraphy has passed into extensive use, and messages have been sent over an aerial space of five hundred feet, the distance between the wires and cars. Its proven ability in the prevention of those blood-curdling accidents incident to travel, and its success in the interception of criminals and the



EDISON'S FIRST MICROPHONE TRANSMITTER.

promotion of social comfort, have rendered it an indispensable adjunct to railroads. Mr. Edison, moreover, anticipates a further application of these principles to marine service, in which case balloons, kites and foil-covered sails will take the place of the train roofs, and will be secured to the apparatus on board.

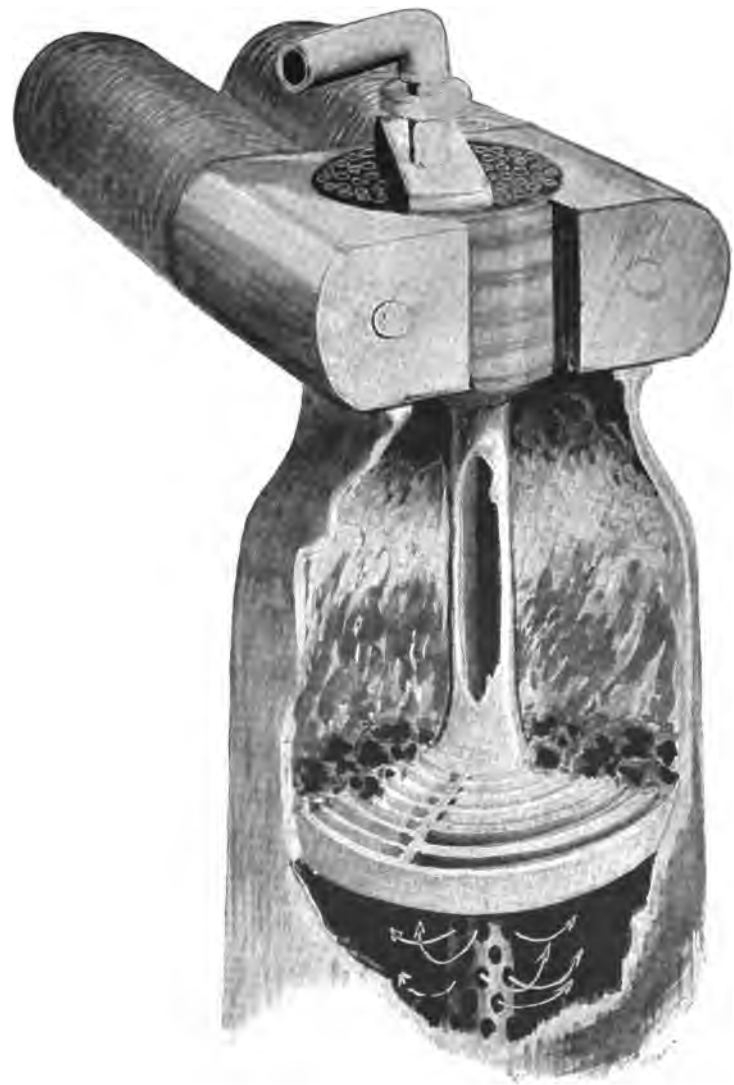
The phonoplex is in the same line of thought as the duplex telegraph, and occupies the middle ground between telegraphy

and telephony. An excellent feature of this system, and one which should enlist the respect of all familiar with our climatic vagaries, is its ability to work in evil weather, and under conditions which render the Morse system impracticable, from the leakage along the line.

THE PYRO-MAGNETIC GENERATOR.

From the borderland, presented by the phonoplex, we pass to the thickly populated regions of telephony, than which no region of electrical science has been more extensively and successfully exploited. In this department we find such a multiplicity of forms, that no manual, however ponderous and verbose, could hope to exhaust the theme. The water telephone, chemical telephone, electrostatic telephone, inertia telephone, mercury telephone, voltaic pile telephone and musical transmitters, are simply specimens of Mr. Edison's varied achievements in this line.

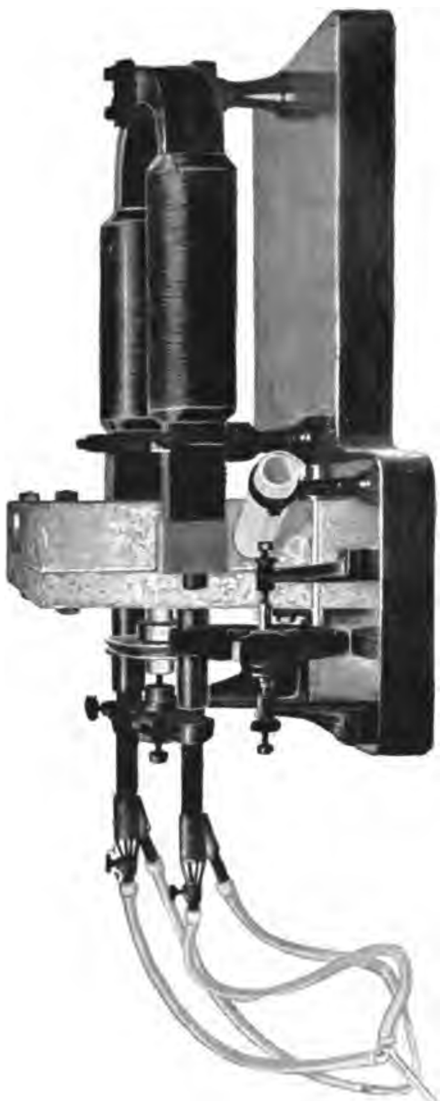
Every grade of employment, every requirement of existence come within the range of this flexible invention, and are met in public life by what is familiarly known as the telephone exchange, a system by which the central office is connected by electric wires to the subscriber's house or place of business, each man being supplied with an individual wire and an accurate list of his fellow-subscribers, with any one of whom he may communicate through the medium of the central office, and with-



INTERIOR OF THE PYRO-MAGNETIC MOTOR—HEATED BY COAL.

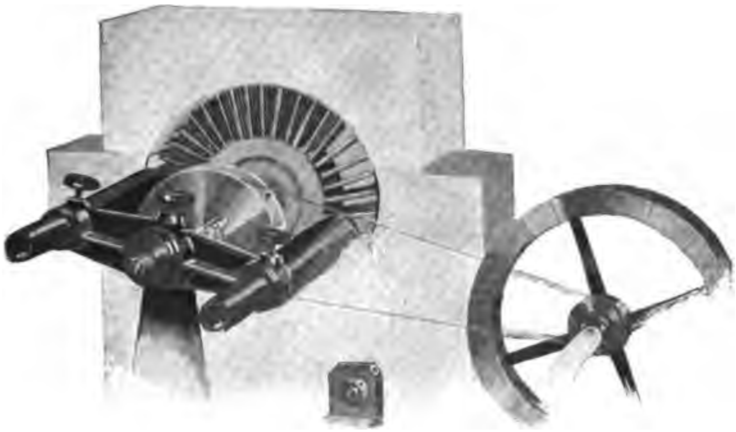
out the necessity of quitting his own comfortable quarters. The time, trouble and expense saved are something incalculable, and offer a striking contrast to former methods, which were wont to render the "calling up" of a fellow citizen about as

delicate a task as the mystic offices of Endor's witch. "Why hast thou disquieted me to bring me up?" must often have been the feeling interrogatory of a fellow civilian, after one of these fatiguing and fruitless interviews. The superiority of the new methods is vindicated by the astonishing growth and multiplication of the telephonic exchanges on both sides of the Atlantic—New York city alone numbering several thousand subscribers.



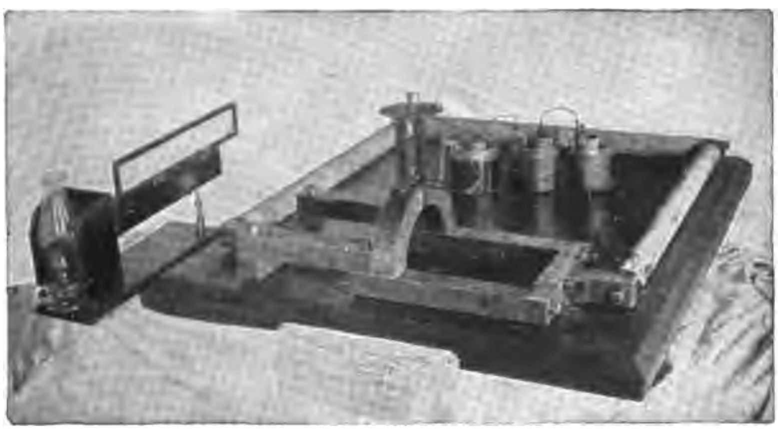
EDISON PYRO-MAGNETIC MOTOR—GAS TYPE.

In the line of magnetic experiments, the pyro-magnetic motor and pyro-magnetic generator are interesting, as reviving an ancient principle, discovered by Sir William Gilbert, a learned physician at the court of the virgin queen. This wise man, whose important and well digested contributions to electrical science have earned for him the title of the first electrician, and whose attainments moved the envy of the illustrious Galileo, published a work in 1600, entitled "De arte Magnetica," which has recently been translated and published by John Wiley



FRONT VIEW OF THE PYRO-MAGNETIC MOTOR—GAS TYPE.

& Sons, of New York. It is remarkable for its systematic and inductive thought, and demonstrates the diminution of magnetic power in iron, under conditions of extreme heat, the magnet failing to exert any influence on the red-hot metal. Edison gave a material encasement to this ghost of primitive science by the creation of the pyro-magnetic motor, a machine in which a pivoted bar is heated and cooled, by turns, being



THE MAGNETIC BRIDGE.

attracted toward the electric magnet when cold, and left uninfluenced while hot, the alternation producing the rotary motion.

The pyro-magnetic generator is based on substantially the same principles, with the end in view of producing electricity directly from coal.

"To do this," remarked Mr. Edison, "has long occupied the close attention of investigators. Could the enormous energy, latent in coal, be made to appear as electric energy, with remarkable economy, the mechanical methods of the entire world would be revolutionized and another great step of progress would be taken."

To the reformer of the future, this concentration of domestic forces is warmly recommended. Imagine a household in which the entire illumination, heating and culinary operations find their origin in one common source of energy, and that, an ordinary and unpretentious coal stove! Truly the appliance has risen in the social scale since those days when Dickens took such virulent exception to its existence. According to that highly imaginative writer, no American establishment, floating or stationary, could be complete without "the everlasting stove in the midst, hot, suffocating and vaporous as a witch's cauldron." We confess to a fellow feeling for that transatlantic wail, whenever memory reverts to our ostracised grates and hearths, but our attitude toward that national abomination will be materially softened if, as Mr. Edison claims, it can alleviate, in any degree, the crushing burden of domestic misery.

The magnetic bridge may also be briefly mentioned. It is an application of the principles embodied in the Wheatstone Bridge, and its purpose is directed toward testing the quality of the iron, entering into the construction of dynamos, and detecting flaws in that metal or in steel.

CHAPTER XIII.

ELECTRIC RAILROADING. GALVANOMETERS. THE ELECTRIC PEN AND MIMEOGRAPH.

ELECTRIC railroading was among the earliest branches of locomotive science investigated by Mr. Edison, and in this, as in the dryest of his projects, his characteristic humor found play. On one occasion, he conceived the brilliant idea of constructing what he termed a "Mountain Climbing Electric Railroad for South America." With these lofty aspirations in view, he built a track on a down hill grade at an angle of forty degrees, using grippers to catch the rail and ensure a modicum of safety. His experiments in this line received a check one day through the sudden breakage of the grippers, in consequence of which the car rushed down the hill with tremendous velocity, and, to use Edison's turn of phrase, well-nigh pitched the solitary passenger, a small and adventurous boy, "over into the next county."

This was a wild tangent, however, from the sane and legitimate line of electric railroading, which found its basis at Menlo Park, and which was exploited with considerable success in after years. In the earlier stages of this enterprise, Edison invited the directors and shareholders of the road to a trial trip, an invitation which, being couched in irreproachable terms, was accepted with bland and unsuspicious politeness. After the interchange of the usual amenities, the dignitaries took their seats, expecting naturally a decorous exposition of the new sys-

tem, spiced by appropriate and improving conversation, but alas! the irreproachable bearing of these reverend *signori*, far from inspiring respect, aroused the demon of ribald mirth in Edison's degenerate breast. Without the slightest intimation of his purpose, he turned the motive power on full force, and dashed his living freight along at the rate of about forty miles an hour, increasing the speed in proportion to the growing discomfort of his guests. Faster and faster flew the pliant engine, higher and higher rose the terror of the directors, hats floated on the breeze, coat-tails flapped, and frenzied protests clove the air, but Edison, school-boy fashion, was only stimulated into fresh depravity by the agony of his victims, and spared them no pang that his ingenuity could devise.

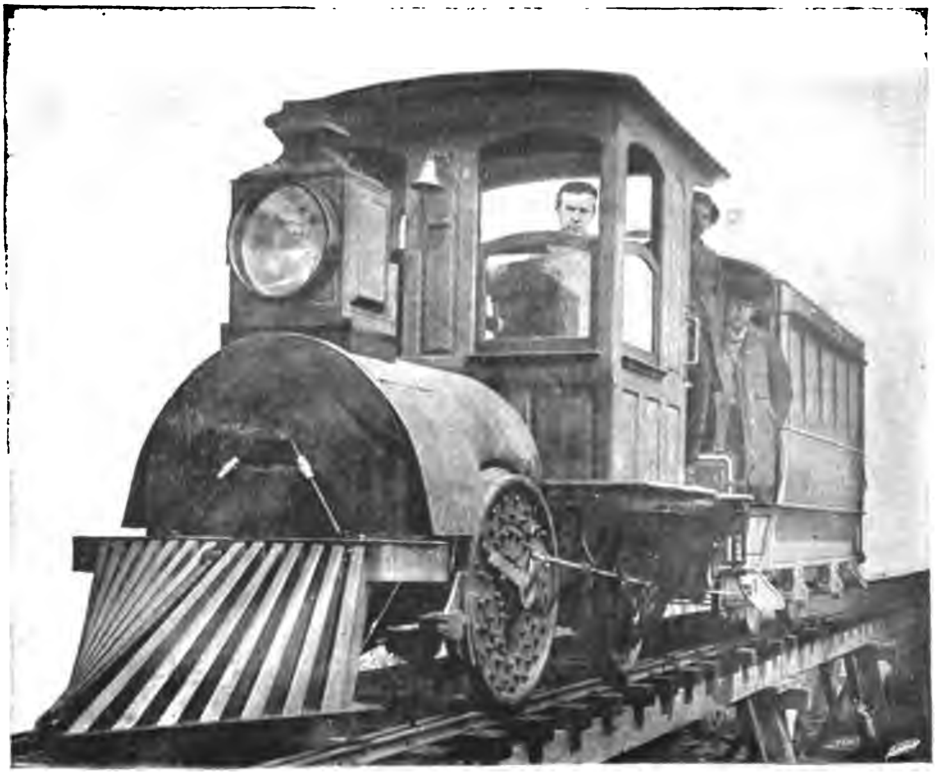
The railroad was a pet scheme of Mr. Edison's. The current was furnished from the laboratory, passing into the rails, which were pitched for insulation from the ground. Entering through the one rail, the current passed up through the wheels, which were also insulated from the shaft, thence to the motor, and out through the other wheel. The electro-motive force, employed at that time, was one hundred and twenty-five volts, and the motor was simply one of Mr. Edison's dynamos, afterwards known as type Z, or sixty-light dynamo.

Shortly after the inauguration of the Menlo Park scheme, Edison found himself confronted by two formidable rivals in electric locomotion, Messrs. Siemens and Field. The claims of the former were dismissed by the court, and a consolidation was effected with the latter, which resulted in the establishment of the Electric Railway Company of the United States. Immediately upon this comfortable adjustment of affairs came the opening of the Chicago Exposition in 1883, and it was determined, despite the paucity of time, materials and accommodation, to indulge the public with a taste of the new project. The enterprise was the outcome of Messrs. Field and Edison's

genius, but so serious were the obstacles encountered, that the exhibit can hardly be said to furnish a just exponent of their methods. Still, the experiment was attended with a large measure of popular success, and derives interest from the fact of its being the first electric railroad, based upon business principles, which has been introduced into this country. The locomotive, which received the cognomen of "The Judge," in honor of the designer's uncle, Chief Justice Field, was five feet wide by twelve in length, and weighed in the neighborhood of three tons. A "throttle valve," very similar to the arrangements for the regulation of speed now existing on American railroads, enabled the engineer to control the electric force at his command, and to slacken or accelerate at will. He also controlled an apparatus for the reversal of the current and the backing of the locomotive, and was provided with an electric bell, having a resistance of three hundred ohms, which served as a safeguard against the diversion of the current from the motor.

The track was laid in the gallery of the main exhibition building, extending along the sides, and curving abruptly at either end, with a radius of sixty-five feet, the entire length covered being about one-third of a mile and comprising three rails, the central one utilized for conveying the current, the two outer ones securing its return. The original project had looked to a maximum speed of twelve miles an hour and the running of two passenger cars, but these ambitious designs were perforce modified to meet the enfeebled constitution of the gallery, which resented the imposition of increased weight and impetus by the most alarming symptoms of collapse. It was therefore deemed imprudent to exceed nine miles an hour, but the defective rate of progress was counteracted by that delicious sense of peril, which is among the many incongruities of our chaotic nature.

"The Judge" covered himself with glory, and proved more than a nine days' wonder. During the thirteen days of its



EDISON DRIVING HIS FIRST ELECTRIC LOCOMOTIVE.

operations, it carried a total of 28,805 passengers, and accomplished 1588 trips. The high water mark of popular patronage was reached on the closing day of its exhibition, Saturday, June 23, when 194 trips were made, and 3580 people transported, in more senses than one. After its successful début at Chicago, "The Judge" was despatched to the Louisville Exposition, where an electric railway had been prepared for his accommodation, and where a reception was accorded him, in keeping with his judicial rank. Mr. Edison has continued his experiments in this line, but not with the full concentration of his intellect, his powers having been mainly directed toward the fruition of the phonograph, the electric light and the telephonic

and telegraphic systems. He has not abandoned the idea, however, as a brisk and extensive electric locomotion testifies, and he anticipates a time when we shall be flashed through space at the rate of over one hundred miles an hour—a speed invaluable to business men, but hardly compatible with a lingering contemplation of the landscape.

DRIVING MECHANISM OF EDISON'S FIRST ELECTRIC LOCOMOTIVE.

Much excellent work was also accomplished by Mr. Edison in the line of galvanometers, amongst which the dead beat galvanometer marks a new departure, differing from other instruments in its ability to dispense with the usual coils and magnetic needles. Its operation is dependent on the heating of the current, which causes the expansion of a delicate platinum-iridium wire, encased in a glass tube. This expansion sets a coiled spring in motion and causes it to act upon a pivotal shaft, to

THE DEAD BEAT GALVANOMETER.

which is attached an exceedingly small mirror, the desired indications being furnished by the projection of the light rays upon the scale. The title of the instrument is a suggestive one. Let us hope that it is not based on Mr. Edison's sensations in the process of investigation.

About this time, 1883, the electric pen or autographic press, an instrument intended for the multiplication of documents, pictures, etc., became the subject of Edison's diversified genius, and being subjected to a hot-house process of fruition, soon made its appearance in the commercial world, where its rapidity and inexpensiveness brought it into extensive demand. The results attained by this ingenious instrument were practically those afforded by lithography, with the advantage of being so easily manipulated as to be independent of expert skill. It is shaped like an ordinary pen-holder, hollowed out to receive a needle-pointed steel shaft, which is driven up and down at a

high speed by a small, light motor attached to the top of the holder, from which a flexible cord passes to the battery.

The primary operations of the penman result in a series of very fine punctures, which are distinctly visible when subjected to the transmitted light. A sheet of fresh paper is placed under the perforated page, and an ink-roller, saturated with ink, is passed over the punctures, with the result of securing an exact reproduction of the original, not, as might be supposed, by a series of dots, but in a continuous line. This latter and somewhat curious phenomenon is due to the exceedingly close proximity of the holes.

A writer gifted with a humorous turn of mind remarked that "if the intelligent public would imagine the 'business end' of an irate wasp, suspended between the operator's thumb and finger, and venting its pent-up feelings by stinging a succession of holes through a sheet of paper, some idea might be gained of the electric pen and its workings."

Little impetus was required to set the delicately poised brain of the inventor in motion, and it is said that the first idea of the electric pen originated in the remark of a friend and prominent merchant relative to the restrictions of ordinary caligraphy: "Why in creation, Edison," said this much-tried individual, "don't you turn your attention to inventing something that would save this endless waste of time and labor?" This cursory hint was sufficient for the scientist's alert mind, and the electric pen was the result.

A modification of the electric pen, the mimeograph, followed almost immediately upon its production, and being of simpler construction and based upon more economical principles, it speedily secured the approbation of that feverish portion of the public to whom time means money.

A sheet of thin waxed paper is placed over a steel plate, roughened like a very fine file, and presenting a surface of

very sharp points. By writing on the prepared paper with a smooth, steel-pointed tool or stylus, perforations may be made, almost identical with the ones accomplished by the electrical pen, the process of duplication by means of the ink-roller being the same. As many as two thousand copies from one writing have been secured by these methods, all finely toned and

THE ELECTRIC PEN.

exquisitely legible, while the saving of time, strength and expenditure are so marked as to constitute an era even in this age of commercial and literary compactness. Used in connection with the typewriter, a recent and highly effective partnership, a manifold reproduction of matter is secured by means of a sheet of prepared stencil paper, used with a perforating silk, in place of the ordinary ribbon.

From the standpoint of romance and picturesqueness, the electric pen and mimeograph, with their commonplace exterior and undignified celerity, contrast unfavorably with the splendor and stately deliberation of ancient methods; but this is essentially a utilitarian age, and it behooves us, with what grace we can, to accept the inevitable. Yet a love of beauty is inborn in the human breast, and on those rare occasions when "Reason, that valiant Captayne of ye sowle," lies at ease within the poppied gates of sleep, the vagrant faculties are very apt to play truant and seek entrance to the tempting and illogical playgrounds of the Past. Then does the mind, released from that grim thralldom, revert with loving tenacity to the glowing pictures which stud the pages of history.

Assyrian despots, scintillating with gems, and robed in cunning needle-work, bending their swart brows over cylinders of terra cotta, or grinding their heavy, triangular implement over a surface of moistened clay, in the wedge-shaped signs, so characteristic of the invincible sons of Ashur!

Stern-visaged Egyptian rulers, enthroned amid vistas of solemn colossi, and entrenched in an inscrutable calm, which borrowed no warmth from the mellow radiance of the setting sun! Seti the wise, Hatasu the arrogant, Rameses the divinely beautiful—inscribing their inflexible decrees on scrolls of Nile-born papyrus, while the swelling chorus echoed through the illimitable courts:

> "Work, my brother, while 'tis day—
> Pharaoh lives forever!
> Rivers waste and wane away,
> Marble crumbles down like clay,
> Nations dwindle to decay;
> But Pharaoh lives forever!"

Toga-ed and fibula-ed exquisites, votaries of Tibullus and Anacreon, their scented locks bathed in dews which never

owned Parnassus, registering their ephemeral vows on tablets of virgin wax, and compelled to many erasures, through the reversal of the stylus, by the restrictions of an intellect made inert by deep draughts of spiced Falernian!

Kings of the Scandinavian seas, azure mantled and wing helmeted, clad in mail of precious metals, demi-gods in stature and in comeliness, cutting the Runic symbols at point of battle sword through the fragrant fibres of birch bark and pine, the while the great war dragons chafe at their hempen gyves, and voice of northern wind and thunder of ocean surges unite in a wild pæan of impending victory!

Dim oratories in mediæval cloisters, lit by casements

> "high and triple arched,
> All garlanded with carven imageries
> And diamonded with panes of quaint device,
> Innumerable of stains and splendid dyes,
> As are the tiger moth's deep damasked wings."

Pale monks, on whose wasted hands and sunken temples "rose bloom and softest amethyst" fall unheeded, and from whose hearts the chapel harmonies, "yearning like a God in pain," evoke only a dim sense of loss—inscribing with anxious care, on sheets of pearly vellum, the jeweled characters, destined to illuminate the darkened hearts and minds of mediæval life!

Alas!—

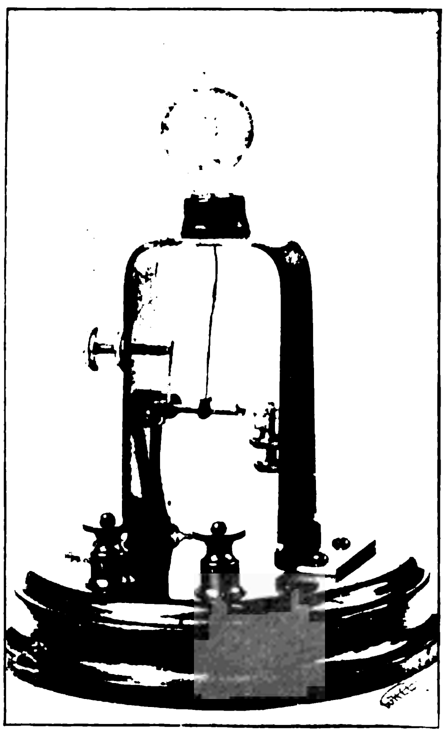
> "The classic days, the mothers of romance,
> That roused a nation for a woman's glance;
> The age of mystery with its hoarded power,
> That girt the tyrant in his storied tower,
> Have passed and faded like a dream of youth,
> And riper eras ask for history's truth."

CHAPTER XIV.

THE ELECTRIC LIGHT. THE ARC AND INCANDESCENT. GROWTH OF THE TWO SYSTEMS. THE EDISON LIGHT. EARLY EXPERIMENTS.

WHEN the breathings of Marsyas' flute trenched upon the golden harmonies of Phœbus Apollo, and the glowing fabric of Arachne outvied the textile intricacies of Pallas; when the spell of Arion smoothed the wrinkled brow of Oceanus, and the gates of Hades rolled sullenly back on their adamantine hinges at the magic strains of Orpheus, then were the attributes of Olympus endangered, and the gods themselves ashamed because of their earthly children. But the majesty of heaven entrenched itself in the mysterious and deadly arsenal of the skies, in the thunderbolts of Zeus, the steel blue Aegis of the sheet lightning, the forked spears and chains of deadly fire. Century after century rolled its waters into the gulf of time, and with each successive billow the foundations of Olympus trembled. Most potent and terrible of all was the tidal wave of the nineteenth century, surcharged with human thought and energy, and enfranchised from the spell of superstitious veneration. One by one the deified forces of nature were dragged from their cloudy thrones, and forced to resign their sceptres into mortal hands. Last of all to yield was sovereign Jove, guardian of the celestial fires. Sullenly the sturdy old Titan walked the paths of men; fettered in his own chain lightnings, he swelled their triumphs and speeded their multiform industries; but the shame of his fallen estate burned within him,

and over the brightness of his presence he folded the forlorn fragments of his imperial palla, lest his foes, seeing his uncovered face, might mock the more cruelly. Alas! within the last few decades, even this poor refuge has been denied him, and that glorious effulgence, which was the emanation and express image of his person, has been stripped from the dying god, and diverted into independent channels. No longer an object of superstitious horror, malign and arbitrary in its influence, the incandescent electric light sheds its pure and potent radiance over the uttermost parts of the earth, and in its steadfast, searching, yet beneficent properties, supplies no mean correspondent of that better "Dayspring from on high which hath visited us, to give light to them that sit in darkness and in the shadow of death, and to guide our feet into the way of Peace."



EDISON'S FIRST LAMP.

It must be borne in mind that the science of electrical lighting takes its rise from two great fountain heads, the arc and the incandescent. The voltaic arc is the progress of electric sparks between two separated carbon points, and the dazzling nature of its luminous effects is produced by the transfer of intensely heated and minutely subdivided carbon from the positive to the negative electrode. Vital objections to the voltaic lie in the

BY KIND PERMISSION OF W. J. JENKS.

CHARLES BATCHELOR READING BY LIGHT OF EDISON'S FIRST LAMPS.

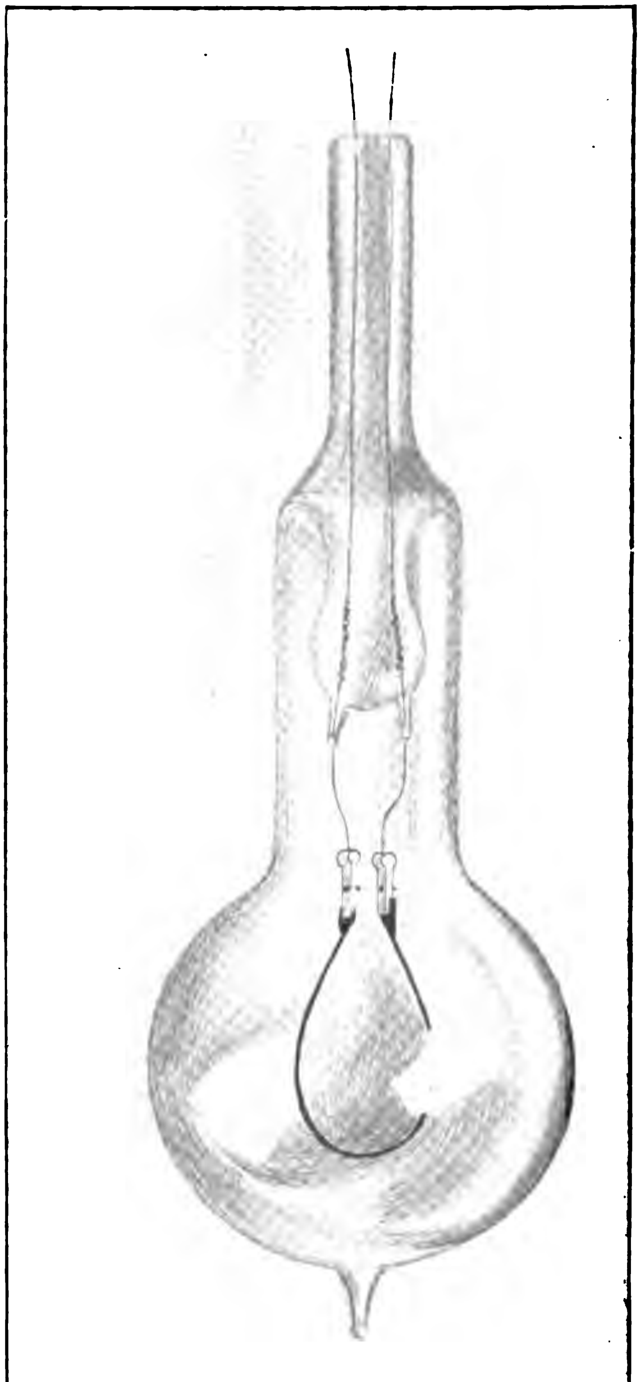
insufficiency of resisting power on the part of the carbon, in its too rapid consumption, and in the need of complicated machinery for the purpose of maintaining a regular current through the carbon electrodes. In the incandescent light, the passage is effected through a substance of high resistance and defective conductivity, such as solid carbon in a state of white heat.

The first practical contribution to the science of electric lighting was made in 1812 by Sir Humphrey Davy, who produced an arc of marvelous brilliancy, four inches in length, capable of extension to seven inches when placed in an exhausted receiver, and utilizing a battery of 2000 cells. The expenses attendant upon the production of this light were so enormous, and the difficulties with which it was interwoven appeared so

insuperable, that the principles of the voltaic arc were abandoned until the year 1834, when Professor Dumas, of Paris, revivified them at the cost of $6 per minute. The enterprise was short-lived, as neither the experimenter nor the French public were in possession of the purse of Fortunatus. Two years later, Daniell introduced a two-fluid battery which tended materially toward the supplying of a steady electric current, and, in 1839, Grove's efforts in the line of electric generators gave renewed life to an art which seemed in danger of entire or partial extinction. In 1844 Foucault's utilization of carbon from the retorts of gas works was attended by a marked degree of success, resulting from the superior hardness of the material and its greater resistance to heat. The science was now sufficiently matured to be put into practical operation, and the season of 1844–1845 witnessed the illumination of the Place de la Concorde, Paris, by arc light, under the auspices of an enterprising electrician, named Délénil.

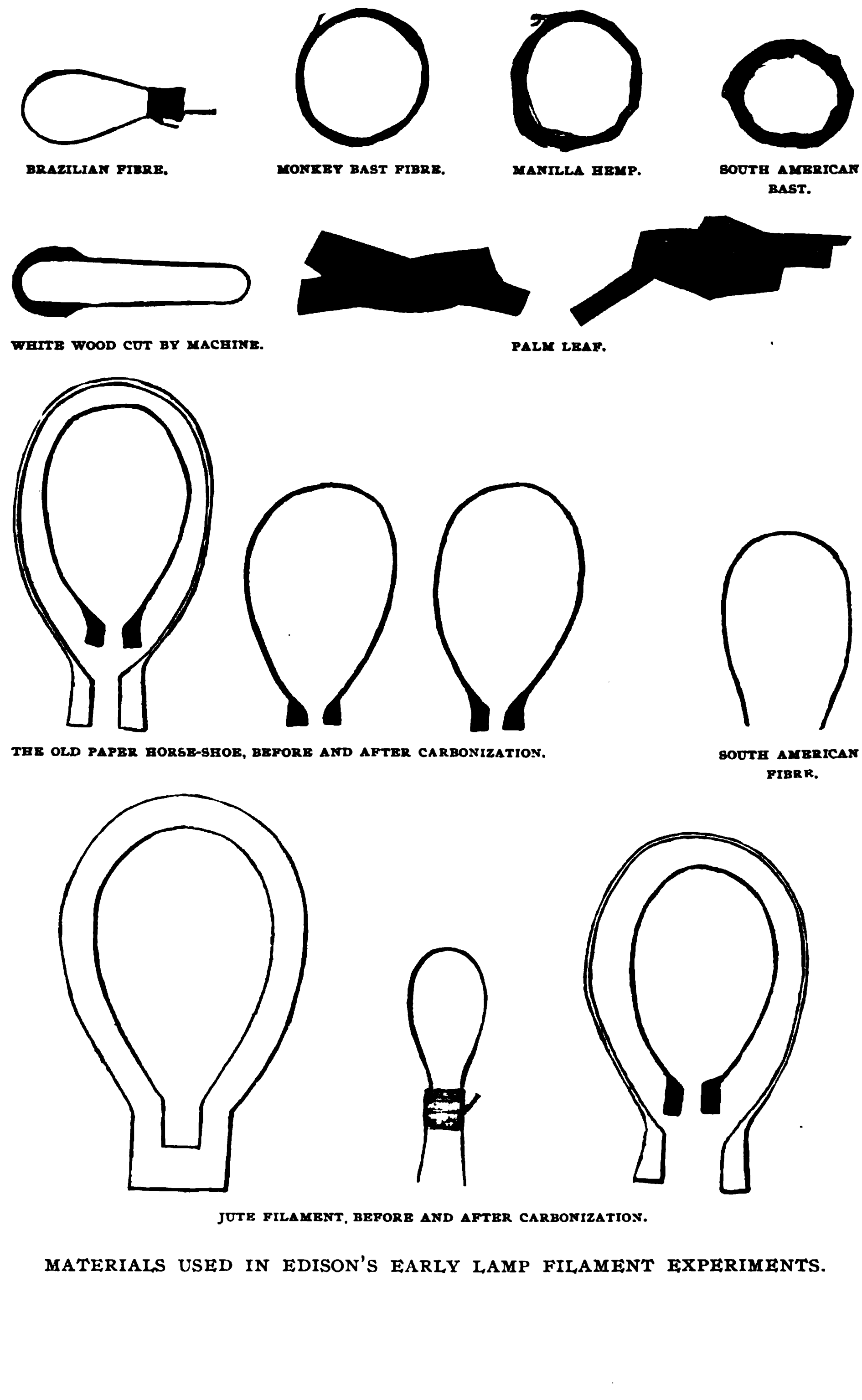
This public test was followed by many others, more or less satisfactory in their results, but the most dazzling and fairy-like display was achieved upon the occasion of the present Czar's coronation, when the utmost resources of the arc light were pressed into service. The capabilities of arc lighting found highest expression in the Jablochkoff candles, the superior attributes of which secured their wide introduction into France and England. The peculiar name of the system is derived from the fact that the mechanism is comprised of two cylindrical pencils of compressed carbon, placed side by side, but separated from each other by kaolin, or plaster of Paris. The insulating substance fuses with incandescence, and becomes a conductor at the temperature of the electric arc. The alternating current is used and a flame is thus secured, similar in appearance to that of the wick of a candle.

The excellent properties of the Jablochkoff candles were



ONE OF EDISON'S EARLY LAMPS.

largely neutralized by one glaring defect. While dispensing with the mechanical contrivances, incident to the regulation of the distances between the points of carbon, for the preservation of the light produced, each candle lasted only a few hours, and this entailed a succession of new burners. It was this feature of the system which especially arrested Mr. Edison's attention, and which caused him to merge his energies into the production of an incandescent solid. Some competitive talent in the principles of incandescent lighting was already in possession of the field, but neither in quantity nor in quality could it compare with the results achieved by the rival branch. An American named Starr, in the year 1845, patented in England the first practical application of platinum. In 1847 Dr. Draper, of New York, conducted a series of experiments, based on the qualities of this metal, highly heated. Despretz followed in 1849, with investigations on the subject of sticks of incandescent carbon, immured in a glass globe, the air of which was exhausted or replaced by nitrogen. So completely was this transaction lost sight of, and so thoroughly were the modest pretensions of the incandescent solid eclipsed by its formidable rival, that in 1873 the St. Petersburg Academy bestowed a medal upon a certain electrician named Lodyguine, and later still, letters patent were issued to Messrs. Sawyer & Mann for the supposed original discovery of a stick of carbon, made incandescent in nitrogen, the identical experiment made by Despretz in 1849. It was in the early spring of 1877 that the defects of electric lighting first enlisted our reformer's abilities, and held them enchained until January, 1878, when the fascinations of the incipient phonograph were again asserted. In those brief ten months, however, much had been accomplished, and the incandescent light had assumed a practical aspect which commended itself to the attention of business men. The outcome of this movement was the incorporation in October, 1878, of the Edison Electric

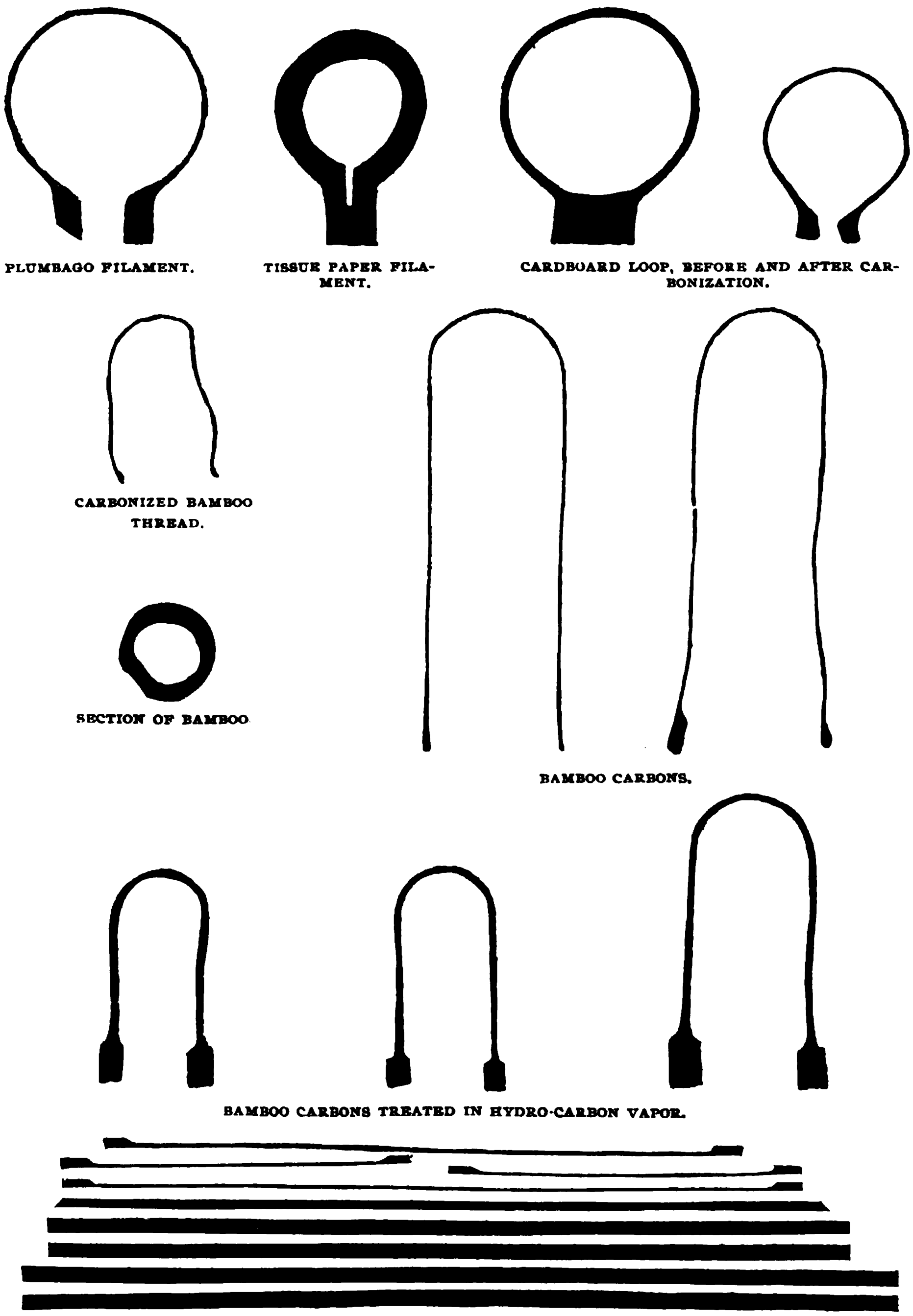


MATERIALS USED IN EDISON'S EARLY LAMP FILAMENT EXPERIMENTS.

Light Company, with a capital of $300,000 and the following directors and organizers: President, Dr. Norvin Greene; secretary, Calvin Goddard; Thomas A. Edison, G. P. Lowrey, Tracy R. Edson, James H. Bowker, R. L. Cutting, Jr., G. R. Kent, N. J. Miller, Robert N. Gallaway, G. W. Soren, G. F. Stone, G. S. Hamlin and E. P. Falbri.

On October 16, 1879, Mr. Edison decided that he had reached conditions where he thought a carbon filament might be made into a lamp to insure stability. A cotton thread was the first substance utilized, and a groove in the shape of a hair-pin was cut in a nickel plate, the groove being just wide enough to hold the thread. This was placed in a small nickel mold and filled with charcoal. Five hours were spent in carbonizing and cooking the mold, after which, upon taking it out of the groove, it was found to be of such extreme fragility that it promptly fell to pieces, even in such practiced hands as Mr. Charles Batchelor's. Repeated experiments were attended by the same disastrous results until a late hour in the night of the 18th, when a filament was rescued intact from its miniature crematory, only to be again fractured in the act of securing it to the conducting wire. "Nature's sweet restorer" had not been invoked by these desperadoes since the commencement of the experiment, on October 16, yet so potent was the spell of inspirational genius, that Mr. Batchelor at once yielded to Mr. Edison's frantic suggestion that they should make a lamp before they slept, or die in the attempt.

On the 19th. several filaments were obtained, all of which broke in clamping, but finally, on the morning of the 20th, after many alterations in the clamping devices, a perfect specimen was secured. In carrying this fragile substance, the focus of so many hopes, from the laboratory to the glass blower building, a malicious zephyr whirled it from its fastening and reduced it to impalpable powder. Utterly unmanned by this misfortune



THE VARIOUS STAGES IN THE PREPARATION OF BAMBOO FILAMENTS AS NOW USED.

MATERIALS USED IN EDISON'S EARLY LAMP FILAMENT EXPERIMENTS.

and unhinged by insomnia and fasting, Mr. Batchelor rushed into the presence of his partner and delivered himself of the following despairing sentiment: "Edison, it's gone, broken by the wind, I'm sick, I'm disgusted. My impression is, that Job got too much reputation on a small capital." But,

> "Heav'n has to all allotted, soon or late,
> Some lucky revolution of their fate,"

and upon the morning of the 21st, events assumed a more fortunate guise. A lamp was finally completed, lighted and eagerly watched by the thirty or more experimenters, attracted by the unusual interest of the proceedings. Partially relieved by the success of the trial, Edison, Batchelor and some others took a few hours' sleep, at the end of which time they were greatly elated to find that the lamp was still burning, without any apparent waste of carbon. This delicate thread of light was anxiously watched for several days, after which Mr. Edison decided to raise the candle-power very high, in order to see how long the carbon would resist the strain. A greater power was attained than the inventor's most audacious dreams had ventured to picture, and sustained through an anxious period of two days, then the soft glow faded, and the tiny filament melted "Like the baseless fabric of a vision." This was the pioneer flame of the Edison incandescent light.

Scarcely had this lamp been burning twenty-four hours, before the entire force of laboratory experimenters, fired with the new enterprise, was engaged in carbonizing every material which promised to yield the desired residuum of charcoal. Filaments of iridium, platinum and other metals were tested, followed by threads, rubbed with coal tar, plumbago and other substances. Later still, Edison experimented with a horse shoe filament, in which a marked degree of success was obtained, insufficient, however, for the ultimate goal of the inventor's

ambition, which looked to the possession of a filament of such inordinate resisting power, as to secure a perfect subdivision of the electric light. In the course of his lucubrations on this

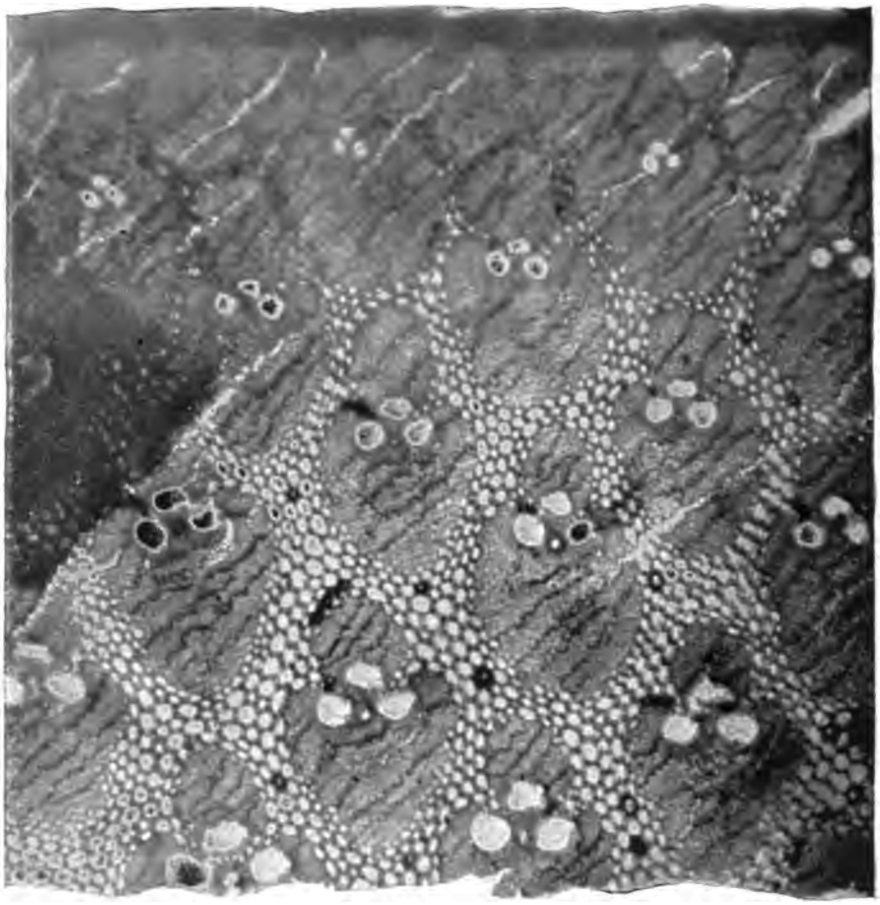


PHOTO BY W. K. L. DICKSON.

MICROPHOTOGRAPH OF BAMBOO SECTION.

subject, a passage of Humboldt suddenly occurred to him, relative to the properties of a certain species of bamboo, growing on the banks of the Amazon. A closer examination of the great naturalist's description convinced him that in vegetable fibres alone could be found the ideal material of which he had

been so long in search, and a band of zealous and experienced agents was soon engaged in the work of investigation.

To Mr. William Moore, whose acquaintance with Mr. Edison dates from 1875, belongs the honor of prior and superior discovery. His investigations in China and Japan, conducted in the year 1880, resulted in the attainment of a variety of bamboo, the fine fibre of which was found to meet the varied needs of the incandescent lamp, furnishing a conductor of the requisite resisting power. The fibre is still in use, and has, so far, met with no superior contestant. Its merits are substantiated in the following letter, written by the inventor to Mr. Moore in 1883:

From T. A. EDISON, 65 Fifth Avenue.

"NEW YORK, November 5, 1883.

"W. H. MOORE, ESQ., Rahway, N. J.

"DEAR SIR—I regret very much to hear that you are about to sever your connection with the Edison Company for Isolated Lighting, and it affords me very great pleasure to testify to your ability and industry in connection with the various matters that you have had in charge on my behalf.

"Your trip to China and Japan on my account, to hunt for bamboo or other fibre, was highly satisfactory to me, as evidenced by the fact that you found exactly what I required for use in connection with the manufacture of my lamps. I was also very much satisfied with the services you rendered me during your connection with the Edison Machine Works, as purchasing agent, and have every reason to believe that you have given perfect satisfaction to the Edison Company for Isolated Lighting during your connection with them; but as to this matter, I have no doubt that they will be willing to speak for themselves.

"Wishing you success, and again expressing my regret that you are about to leave our business, I remain,

"Very truly yours,

"THOMAS A. EDISON."

CHAPTER XV.

FIBRE HUNTING. MC GOWAN'S EXPEDITION TO THE AMAZON.

SATISFACTORY as were the results of Mr. Moore's investigations, Mr. Edison did not rest here, but made assurance doubly sure by extending his researches into other fields. Prominent in the ranks of fibre-hunters was a certain Mr. Frank McGowan, a gentleman of Celtic extraction, endowed with the grit and enterprise peculiar to that favored race. That these qualities were unusual, is evidenced by the terrible hardships he encountered, comprising the most undesirable intimacy with wild beasts, reptiles, fevers and predatory Indians. He pursued the course of the Amazon for 2300 miles, and explored the great continent from the Atlantic to the Pacific, penetrating into districts so ravaged by wild beasts and so heavy with miasmic poison as to be avoided even by the hardy natives. He tasted no meat for 116 days, and did not change his clothes for ninety-eight. His achievements, as a whole, palliate, if they do not wholly justify, the enthusiastic comment of a prominent New York journal: "No hero of mythology or fable ever dared such dragons to rescue some captive goddess as did this dauntless champion of civilization. Theseus, Siegfried or any knight of the fairy books might envy the victims of Edison's irresistible lieutenant."

The history of McGowan's exploits derives added interest from the fact of his sudden and inexplicable disappearance, shortly after his satisfactory discharge of Mr. Edison's commission. Despite the most careful search, in which every imagin-

HUNTING FOR FIBRE—THE EXPLORER'S ASSISTANTS.

able clue was followed up, Mr. McGowan's fate is still wrapped in impenetrable mystery. Two theories divide the field of conjecture. One holds that the daring traveler must have succumbed to the ill health, resultant upon his many hardships, a supposition confirmed by his severe illness immediately upon his return; the other—and this view cannot fail to enlist lovers of the romantic—that Mr. McGowan, in the course of his South American travels, became enamored of a certain lustrous-eyed Senorita, for the better enjoyment of whose society he has withdrawn to the idyllic seclusion of some sweet Eden, within

"Breadths of tropic shade and palms in cluster, knots of Paradise."

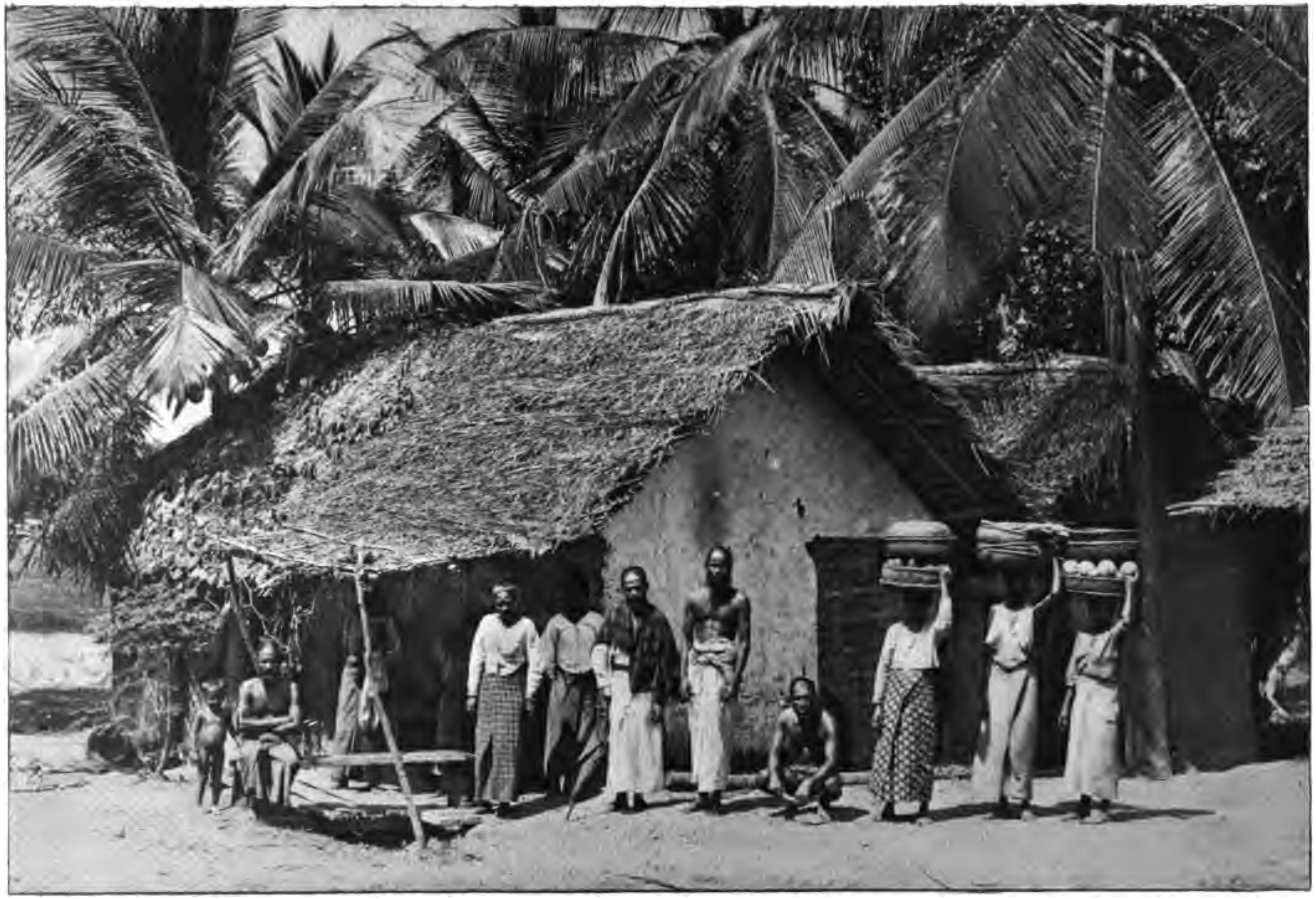
The following hitherto unpublished account of an expedi-

tion to the Amazon, in conjunction with Mr. McGowan, is furnished us through the kindness of Mr. Samuel G. Burn, a member of Mr. Edison's mining force, and himself a traveler of wide experience. It exemplifies in a very striking manner the whole-souled way in which Mr. Edison's associates lend themselves to the furtherance of his views:

A GROUP OF NATIVE CHILDREN.

"My recollections of Frank McGowan's explorations from the time he entered the Amazon until we returned together from the Cauca.

"Nothing of interest transpired during the voyage up the Amazon, but when the navigable portion was passed, McGowan's troubles began, through the refusal of his associate to face the dangers of the upper Amazon and the Napo river. These were represented by the native Indians in colors calculated to damp the ardor of a man less inherently brave and conscientious than McGowan, but they only served to whet his determina-



A NATIVE VILLAGE.

READY FOR A JOURNEY.

tion. 'I'll make the trip, do my duty, or die,' was his sole response to these birds of evil omen.

"McGowan was now thrown on his own resources, supplemented only by the provisions and inefficient aid which he was able to secure from point to point. A few small villages lay on his route along the Napo river, and from these he hoped to derive information and supplies. The distance between his starting point and Quito was about 500 miles, a stretch the extent of which few of our modern travelers can realize. He commenced by hiring a canoe and several Indians, but, unfortunately, twenty-four hours had not elapsed before his cowardly guides showed an unwillingness to abide by the contract, stating their fear of the hostile tribes which they were likely to encounter, and predicting darkly that, if persisted in, this expe-

A PALM TREE AVENUE IN THE FOREST.

dition would result in the death of all the parties involved. It was only by the exercise of his national 'gift of the gab' that McGowan finally allayed their fears and succeeded in inducing them to proceed. The society of these gentlemen was attended by some inconvenience, for although harmless in other respects, they were inveterate thieves, and a strict watch had to be maintained day and night upon the jewelry and other valuables deposited at the bottom of the boat. One Indian alone furnished an exception to the predatory instincts of his mates and was retained throughout McGowan's journey to guard his interests, while the other explorers were engaged in the search for bamboo.

"It was after one of these exploring trips that the Indians finally struck, demanded a settlement of their claims and

departed in a body, taking pains to assure McGowan and his one faithful adherent that they would never live to reach Quito, that journey being attended, in the Indian mind, with the most

A NATIVE BEAUTY.

insurmountable dangers. The two were now alone, having been deserted at the end of thirty-six hours. New Indians were hunted up, and by dint of bribes and other substantial stimu-

lants, were imbued with sufficient courage to undertake the exploration of new sections of the Napo river. It was seldom that these primitive regions afforded any shelter, and when found, it was impossible to remain in them, on account of the flies and other insects. Peaceful sleep could only be enjoyed on

A CINGALESE FEAST.

sand-bars, or in the canoe, tied to a stump, whenever rain seemed imminent. A strict watch had to be kept on the rise of the river, lest the sand-bars on which they were sleeping should be deluged, and the sleeper, blankets, provisions, etc., be carried down the stream. Food could be secured only at intervals, and only by the exhibition of the big shining *peso*, a coin with which McGowan had been bountifully provided. At such

times, provisions for several days were bought, and added to the other stores of the loaded canoe. After eighty-five days of toil and privation, Quito was reached, a triumphant vindication of pluck and energy.

CLIMBING FOR A SPECIMEN.

"The most startling feature of the trip occurred one day while McGowan and his force of Indians were investigating a tract of land, situated about five miles from the Napo river. The different members of the party were scattered, each searching

for the desired bamboo, but the leader took care that they should be within hailing distance, so as to be promptly recalled in case of danger. His precautions proved salutary, for an unusual sound was suddenly heard, which brought every man to the meeting point agreed on, just in time to engage in a general fight with a tiger.

ANXIOUS TO BE PHOTOGRAPHED.

"After spending some time in Quito, McGowan journeyed to Quayaquil; from there, by

A NATIVE BARBER.

steamer, to Buenaventure, and thence by rail, twelve miles to Cordova, this being the full length of the complete road. From Cordova, McGowan started out on foot, sending his baggage by mules, to examine the territory between this point and Cali, or the Cauca valley, a distance of seventy-five miles. Some patches of the bamboo were located on this trip, none of them exceeding four inches in diameter, or forty feet in height. After reaching Cauca a more prolific region was entered, for almost anywhere between

A NATIVE AT WORK.

Cali and Popayan, or head of the Cauca valley, more especially along the banks of the Cauca river, the bamboo grows seventy-five and a hundred feet high, and from six to nine inches in diameter. The graceful curves of the tops of this beautiful grass, towering high above the trees, presented a most striking contrast to the surrounding foliage. It was found that the grass was not confined to the Cauca valley, for following up the mountain rivers, all of which empty into the Cauca, patches of the bamboo were discovered to be numerous, not only in flat places, but in the mountains, being thoroughly moistened by springs. The grass develops to an enormous size, and here it seems the strongest and most healthy. The joints of many of this kind exceed those in the valley, reaching twelve to thirteen inches in length, and eight to nine inches in diameter. Some of these patches are acres in extent, and nothing grows there but the grass and ferns, which are indescribably beautiful and vigorous."

CHAPTER XVI.

HUNTING FOR FIBRES. MR. RICALTON'S ADVENTURES IN THE INDIAN PENINSULA, ETC. FINAL SELECTION OF BAMBOO. STRUCTURE OF LAMPS.

THE searches for suitable bamboo fibre for electric lamp filaments, made in Ceylon, the Indian peninsula, and adjacent countries, were admirably conducted by Mr. Ricalton, the well-known explorer and school principal of Maplewood, N. J. Mr. Edison's discriminating power in the selection of his emissaries was most felicitously illustrated in this instance. To an exhaustive knowledge of natural science, Mr. Ricalton added an unusual faculty for observation, invincible courage, swift powers of decision and an unquenchable love of travel. The latter attribute was observable even in early youth, when his scant economies were invested in a steerage trip on a lake propeller to Michigan. Since that initial voyage, it is estimated that he has covered 45,000 miles, exclusive of the trip taken in Edison's interests, and despite the attractions of an ideal home and an equally ideal family, the responsibilities of a pedagogic career, and other trifling claims, he is, as we write, engaged in another scholarly pilgrimage, which will be doubtless as fruitful in historic and scientific results as its predecessors. Mr. Ricalton furnished the following reminiscences of his researches for Edison:

"On an afternoon in January, 1888, while prosecuting the usual routine of the schoolroom, a recitation was interrupted by

a rap at the door, in answering which a messenger placed in my hand a letter from Thomas A. Edison, which requested me to meet him a few hours later on the same afternoon. A communication from such a source was, of course, a great surprise, and if anything could exceed my surprise, it was my curiosity

PHOTO BY J. RICALTON

HUNTING FOR FIBRE—THE HARBOR OF SINGAPORE.

as to what the 'Wizard' could want of one in the pedagogic line, whether possibly a tutor and disciplinarian for the junior Tommie, or what.

"However, at the hour designated, I was amid the whirr of the great laboratory, and escorted by the very courteous Mr. ——— into the presence of Mr. Edison, whose cordial greeting and simple manner quite removed the trepidation that

PHOTO BY J. RICALTON

CROSSING A RIVER ON INFLATED BULLOCK SKINS.

PHOTO BY J. RICALTON

TRANSPORTING THE EXPLORER'S BULLOCK-SKIN BOAT.

possessed me on being presented to genius. 'You like travel, I believe?' was his first observation. Abbreviating my words to his evident wish to dispatch business, I replied 'Rather.'

"'I want a man to ransack the world for a fibre; how would you like to undertake that?' he continued. 'That would

PHOTO BY J. RICALTON

ONE OF THE COAST TOWNS.

suit me,' I answered. 'How soon could you start?' was his next query. I stated that I must get the permission of the Board of Education to vacate my position as principal of the school, the board must secure a substitute, and then I would require a little time for preparation. 'Oh, I want you to start to-morrow,' exclaimed the great electrician. 'But, Mr. Edison, I must have a little time; you want me to search the world—

the world is large, and I have buttons to sew on.' 'Well,' he continued, 'it is somewhat of an undertaking. It may take you three years, and you may succeed in six months; so lose

PHOTO BY J. RICALTON

A YAK FRUIT TREE.

no time in securing a leave of absence, take a week or two for preparations, come to my laboratory daily during that time for experimentation; when you have concluded your experimental

CINGALESE WOMEN, PHOTOGRAPHED BY MR. RICALTON IN HIS SEARCH FOR FIBRE.

PHOTO BY J. RICALTON

CINGALESE TEA WORKERS.

work, go into the library and study the flora of the tropics; learn the habits of every specie of bamboo, and of fibre-plant; make for yourself maps of the tributaries of the Irrawady and Brahmaputra rivers, and other places you will have occasion to search. In the meantime I will have made for you a complete outfit of tools for testing the fibrous products of the tropics.'

"This summarizes substantially my first interview with Edison concerning my explorations for fibre. A very obliging Board of Education gave cheerfully the necessary leave of absence; two weeks were spent in Mr. Edison's laboratory and library, and on February 22, 1888, I sailed for India, via Liverpool, London, Brindisi and Suez Canal, reaching Colombo in Ceylon, on April 1. Three and a half months were spent in that Eden of tropical luxuriance, where nearly 100 different species of bamboo and palms were found and tested.

"I enlisted in my service native Cingalese guides noted for

PHOTO BY J. RICALTON

ONE OF THE NATIVES THAT THE EXPLORER MET.

their woodcraft and their knowledge of the bamboo family, in which I had most hope of finding the fibre-desideratum. In these searches I visited every part of the island, often sleeping in the dense jungle by a camp-fire where insect pests are multitudinous and merciless; the most revolting specimen of the latter is the land-leech, much smaller but resembling the medical leech, twenty of which, mostly filled with blood, I removed from my body on one occasion, after emerging from the jungle.

"The most magnificent species of the bamboo family, although it is a native of Burmah, is found in Ceylon. It is called the giant bamboo, and clumps of from 100 to 200 may be seen reaching to a height of 120 feet, and measuring from ten to twelve inches in diameter.

"From Ceylon I crossed to India, and proceeded from Cape

Comorin at the extreme south, to the Himalayas, visiting on my way northward the different bamboo regions, using the same methods as in Ceylon to obtain samples of every species, sometimes offering to the natives premiums for new specimens. After exploring the jungles in the vicinity of Pondicherry, Bangalore, Madras, Bombay and Delhi, I tested all the different fibre-wood at the base of the Himalayas; then I worked my way into the high lands as far as the Sutlej river, where civilization is so attenuated that the only means of crossing the river is on inflated bullock skins.

"From the Sutlej I descended to the plain and followed the Ganges to its mouth. On the north of Calcutta I again ascended the Himalayas to an altitude of 6000 feet, where I found some

PHOTO BY J. RICALTON

DOMESTIC ECONOMY IN THE EAST.

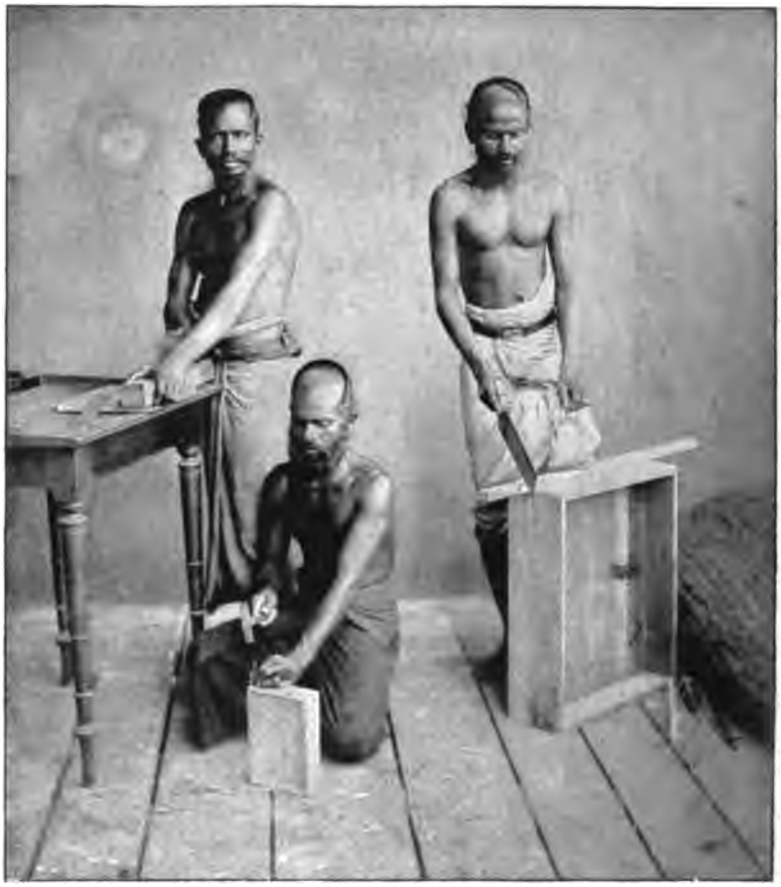


PHOTO BY J. RICALTON

THE CARPENTERS WHO BOXED THE BAMBOO.

fine specimens of the bamboo family. Descending the Himalayan range again, I entered Assam, and ascended the Brahmaputra several hundred miles, testing everything en route, then returning to Calcutta via Dacca.

"From Calcutta I sailed to Rangoon in Burmah. From Rangoon I followed the Irrawady to Mandelay, using the same methods in obtaining and testing fibre samples at the different points. From Burmah I followed the Malayan coast to Singapore, where I again collected from the surrounding country, tested and proceeded to Hong Kong; thence to Canton, where

I secured specimens of every variety. I did the same in Japan, where the search was much simplified by the complete collections of bamboos in the Botanical Gardens and Museum at Tokio.


PHOTO BY J. RICALTON

A NATIVE BERRY PICKER.

"When I left the laboratory, Mr. Edison placed in my hand a sample of bamboo about which he said, 'If you find as good as that I will be satisfied.' In two localities of the tropical belt through which I had passed, I found fibre which stood a much

higher test, as a carbon, than that furnished as a satisfactory sample by Mr. Edison, but I have since learned that its splitting qualities are not so good. My search was intended to include Java, Borneo and other East India islands; but, with perfect confidence in the sufficiency of two different fibres already found,

PHOTO BY J. RICALTON

A HOLIDAY GROUP.

I turned my course from Japan toward San Francisco, and reached home on the following 22d of February.

"On my return, Mr. Edison, I was informed, was using an artificial carbon which he then expected would supersede the bamboo, and whether any practical use has ever been made of the fibres found I have never learned. The first time I met Mr. Edison after my return, I shall not soon forget, as showing

how ordinarily important things are looked upon as trifles in a mind so fully occupied. I had spent a year in an unusually hazardous search, embracing a circuit of the globe, and entailing an expense that would be a fortune to many a toiler. He was passing through the laboratory on his incessant supervisory work; he extended his hand, smiled, and with a brief 'Did you get it?' hurried on to the thousand and one exigencies with which his wondrously busy life is filled.

PHOTO BY J. RICALTON

A NATIVE WEAVER.

"When I set out on my journey of discovery, I felt it an honor to serve one whom I have learned to regard as the most widely known man in the world to-day. In all my journeyings I have been many times astonished to find his name so well-known; even the unlettered natives of half-civilized countries have learned to associate his name with the electric light. My donkey-boy in the streets of Cairo was endeavoring in broken English to tell me something about the Khedive, whereupon I asked him the name of our American Khedive. He shook his head to tell me he did not know. I mentioned the name

Harrison, but he did not recognize it; then I mentioned Edison's name; he smiled cognizantly and drawled the name—'Ed-ee-sone' while pointing up to an electric light before the hotel. Only a few weeks ago I mentioned the name to my courier in Morocco, whereupon he quickly proceeded to offer his knowledge of the man. Edison's name is truly a household word to the ends of the earth."

PHOTO BY J. RICALTON

A CINGALESE WOMAN.

No fewer than eighty varieties of bamboo and 3000 kinds of vegetable fibre were tested successively in the fruition of the electric light, and it was found that of this incredible number, only some three or four possessed the desired attributes. The preparation of the materials necessitated the greatest care. The sole portion available were the delicate fibres immediately underlying the bark, and these, under certain conditions of maturity, were subjected to a special process of carbonization, resulting in the elimination of all volatile matter, and the presence of a cellular structure, admirably adapted for the purpose required.

The structure of the lamps, in the meanwhile, had undergone important modifications. In the fall of 1879, the lamp presented the shape of a nearly globular bulb with an elongated neck, and filatures which extended to the inside of the lamp; the platinum leading-in wires were sealed to the summit of the interior, the tips on the globe were pointed and hollow, and

platinum clamps were utilized. Within the next two or three months the shape of the globe had again been altered and was considerably enlarged, in deference to the belief that the defective burning power was due to the contracted dimensions of the enclosing chamber. At this point the comparative elimination of air was secured, although the sealing of the glass tops was rough and inefficient. Later in the spring of 1880, a species of white German glass was utilized at the junction of the platinum wires with the glass for the purpose of securing a more perfect seal. This was discontinued in the fall of the same year, and the shape of the globe was modified to meet the requirements of the bamboo filaments to which we have alluded. In the winter of 1880, the lamp had reached greater durability, the supplemental tips at the summit were shortened, and the platinum leading wires introduced through the glass interior were solidified and rendered more compact by being compressed into shape while hot and malleable. Other lamps, constructed at this period, show novel features, such as the use of a wooden socket—and the wires coming from the lamp are soldered to contact rings, insulated from each other, one plain and the other threaded to facilitate making contact in the lamp socket. In January of 1881, tests were made, with a view to substituting the cheaper metals, silver or copper, for the platinum used in the construction of the clamps, and the contact between the carbon filament and the platinum wires was materially improved. Further changes followed in the substitution of plaster of Paris sockets instead of wood, in the heightened resistance of the bamboo filament, and the superior symmetry of the general proportions. Between this type and the perfected lamp of the present day, there are fewer points of dissimilarity than between any other of the several forms of evolution. The difference consists mainly in the use of carbon paste, in the omission of the supplemental tip, in the attenuation of the filament and in

the substitution of a brass contact plate and threaded brass ring for the contact rings alluded to above. The spring of 1881 gave birth to the first permanent record of electric light, in the shape of an incandescent lamp, which lasted 1589 hours, at a height of sixteen candle-power.

CHAPTER XVII.

BEHIND THE SCENES WITH THE EXPERIMENTERS. DEATH OF MRS. EDISON. THE GOERCK STREET WORKS.

THE strain of continuous thought and manual exertion attendant on the production of the electric light and other inventions was lightened in Edison's own characteristic fashion, for, although unsparing to himself, he was possessed of a kindly consideration for those less mentally and physically endowed. It must be confessed that during the periods of inspirational insanity these humane scruples were generally lost sight of, but no sooner were the desired results attained than a healthful reaction set in, and the entire force would be dispatched on what Samantha appropriately terms "a pleasure exertion."

To this end Edison was wont to charter a certain brick sloop, in harborage at Woodbridge, supplying her with provisions, fishing tackle, and whatever might be supposed to contribute toward the building up and relaxing of the human system. This cosy and capacious craft became the scene of piscatory exploits many and marvelous, in which the promoter of the enterprise bore an illustrious part. The feeling of unbent jollity which reigned on those occasions received a decided impetus from the chief's presence, for Edison knew how to throw himself into these harmless dissipations without impairing his legitimate authority. His bonhomie, kindly humor and unostentatiousness were calculated to call forth the best qualities in those around him, but of all his attributes, none appealed

so forcibly to the men as the master's efforts to shield them from adverse criticisms.

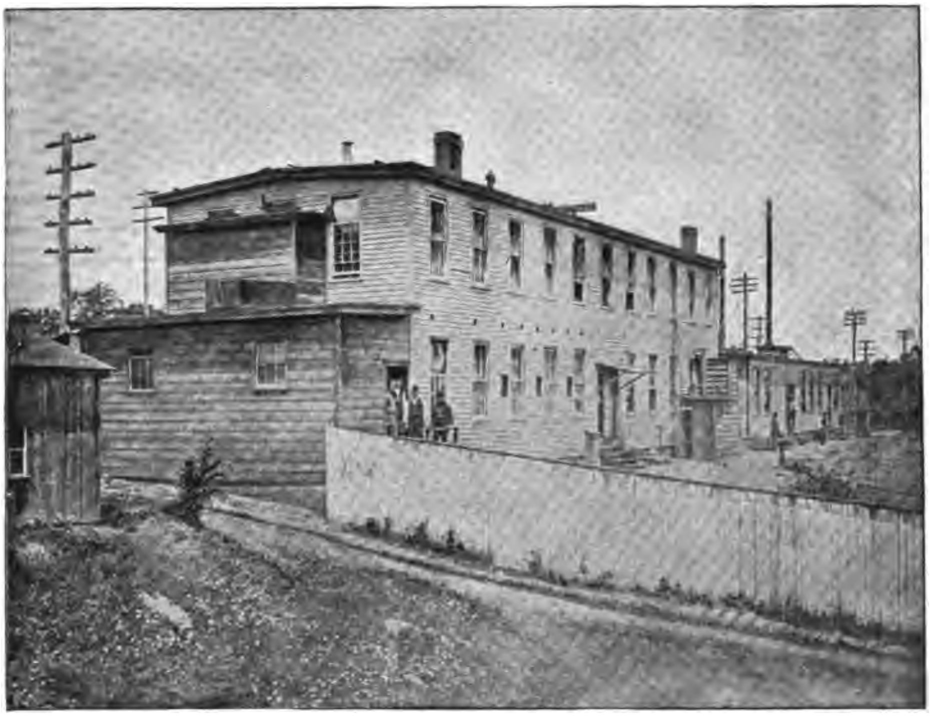
On one occasion, an associate of Mr. Edison was called upon to give the bearings of some intricate electrical problem before an august board of inquiry, and in so doing was betrayed into several inaccuracies. These were taken exception to by the members, but the general verdict was waived in consequence of Mr. Edison's authoritative support of his protégé. No sooner, however, was the room cleared, than the chief turned to the young man with the remark—"Now here, you were wrong about that affair. I saw that at a glance." "You did, Mr. Edison," rejoined the other, amazed. "Then why did you endorse me?" "Because I wasn't going to let those duffers have the satisfaction of crowing over you, if I could help it," was the reply.

Mr. Edison indulges in no harsh methods to secure obedience, and the most timid neophyte meets with an easy and kindly simplicity which invariably has the effect of reviving his paralyzed faculties. Intelligent ignorance has nothing to fear from the master's superior abilities, but pretension and finicky elegance are certain to call forth Edison's powers of sarcasm, and a demure assumption of the discarded duties.

A dudish applicant, with an overweening sense of his own self-importance, once refused to perform some of the rough work attendant on an important experiment.

"Why should we only toil, the roof and crown of things?"

he demanded, in substance, if not in phraseology. Edison indulged in no scathing rebukes, nor did he abruptly dismiss the applicant, as a less gifted psychologist would have done. He simply apologized with elaborate courtesy for having taken the liberty of suggesting manual labor in connection with so distinguished an aspirant for electrical honors, and, rolling up



THE EDISON LAMP WORKS AT MENLO PARK, N. J., IN 1880.

his sleeves, plunged into the work himself, shrinking from neither dirt nor fatigue in the prosecution of his object. The lesson was efficient and never required to be repeated. The youth was possessed of some saving grace under his spurious elegance, and the example of his chief bore lasting results in his subsequent career.

Menlo Park was in the early eighties a spot not unworthy of that class of students whose energies are engaged in the perennial search for novelty. There were strange doings in that den of scientific lunatics, scenes which must have drawn tears from the eyes of our Puritan ancestors, and awakened the virtuous indignation of those dwellers in Wormeldingen, where "the homes are washed and waxed, and the streets brushed and dusted, till not a straw lies about, and the trees have a combed

and brushed appearance, and do not dare to grow a leaf out of its place." If, during the progress of some pregnant electrical problem, a casual visitor had stepped in, his eyes would have rested on the unhallowed spectacle of a great workshop in the last stage of inartistic disorder; men lying in attitudes more suggestive of ease than elegance, taking what sleep they could on tables, benches and floor; others plying their labors with tense brows and bloodshot eyes, while the master was calmly slumbering amid the general turmoil, his unkempt head supported by a stick of wood, round which an overcoat was carelessly flung. Thirty men were usually at work in this room, sometimes for forty and sixty hours at a time. These abnormal tests of endurance were generally enlivened by choice selections on the organ, presumably of that order which prompted the paraphrase on Collins' "Ode to the Passions,"

> "When Music, heavenly maid, was young,
> It's then she oughter had been hung."

Jokes scintillated, yarns were spun, songs and recitations fluent, rose-colored vapors which buoyed up Time's laggard pinions to a marvelous degree. But the real motive power lay deeper than these superficial palliatives, and was embodied in the affectionate and intelligent zeal of the men.

"These were the pioneers of the electric light," said Mr. Edison, "and to their faithful labors is due the widespread introduction of the system."

From this tried and trusty phalanx five men were selected and entrusted with the important charge of the incandescent lamp, in connection with the French Electrical Exposition of 1883. The concentrated and sustained energy which they displayed in the promotion of Edison's interests was such as to attract universal comment. The Gaul, whose field of action lies rather in the achievement of daring and short-lived deeds, and whose

excitable temperament lends itself but seldom to feats involving sustained endurance, looked with open-eyed wonder on this band of men, toiling night and day, without adequate food, rest or sleep, in the interests of an employer thousands of miles away. Service of so exacting a nature, and of which Virtue furnished almost the sole reward, had never entered within the observatory scope of the Frenchman, and he was fain to dismiss the subject with a contemptuous shrug, as a fresh proof of foreign eccentricity.

It was during the Menlo Park campaign that Edison's counterfeit presentment was secured in the shape of a plaster cast, and at a cost which should render it valuable to the lovers of phrenological science. The harrowing details of the transaction are detailed for this work by the artist, Mr. J. E. Kelly:

"Arriving at Menlo Park, I met Mr. Austin of Fowler & Wells, with a molder who had an appointment to make a cast of Edison's head for their phrenological collection. He got to work first. It was in the upper floor of the laboratory. Edison seating himself in an arm-chair, with a towel round his shoulders as though about to be shaved, put himself in the hands of the little molder, while a lot of old gentlemen, whom I understood to be interested in educational establishments, formed a curious circle. The molder, having oiled Edison's face and smeared his hair, mixed the plaster and proceeded to put it on the back of the head, leaving the face and neck uncovered. The plaster having set, he put pieces of tissue paper over his eyes, patting them down to give the form, and rolling little cones of paper, placed them on the nostrils. Then oiling the edge of the back mold, he began to pile up the plaster, gradually approaching the mouth. Edison in a forlorn voice said, 'Kelly, good-bye;' and then a handful of plaster closed his communication with us for the time being. The face and head being entirely covered and very heavy, his nephew, Charley

Edison, supported it on his shoulder, while the general effect was like a diver's helmet with the ends of the paper cones sticking out like tusks. He groped with his hand, and Charley taking it, he began to tap on the palm of it with his fingers as though telegraphing—Charley grinned—'What does the Professor say?' said one of the old gentlemen. Charley hesitated. The old gentleman, evidently expecting something very profound, insisted on knowing. He says: 'If I should fall back, it will break my damn neck.' The whistle of the train sounded just then, so, grabbing his hand, I ran toward the station. A man ran after me saying Mr. Edison wanted me. 'How do you know?' I demanded. The man replied 'He started when you shook his hand and signaled to know what it was. They told him you had left, so he said he wished you to wait till the eleven o'clock train.' On my return he asked for a sounder, and then the fun began. He described all his sensations; how the plaster felt while setting; cracked jokes, and made those quaint suggestions so characteristic of him. While the assistants fanned the mouths of the little cones, the plaster having set, the mask was removed easily, and he beamed out on us with a white circle round his head like a baby's ruffled cap.

"On trying to remove the back mold, to their horror they found that it was stuck to his hair, and they could not budge it. Then the nerve and character of the man showed themselves. Calling to his machinist, he told him to make a thin, pliable steel ribbon, shaped and sharpened like a sickle at the end, and to work it down between the scalp and the plaster. He then placed his feet on the window-sill with his toes against the glass and the torture began. They would run steel under the cast, then they would cut away the hair, then it would strike a bump and the blood would come; that would scare them and they would try to work it off, that would pull the hair out, and little tufts would come off the plaster as they partially removed

it. All the time when his jaws were not set, he would look and talk in his old kind and cheerful manner. Not once did he show impatience or nervousness during those three hours they tortured him.

"I expected at least some nervous twitch would send his feet through the window; but they hardly moved, certainly not with impatience.

"At last the mold was removed. The inventor's face and head were streaked with blood and grease, his hair all jagged, and pieces of it lay round. He got up, and as he was going West next day with a scientific party, to prove his new instrument invented to test the heat of the stars on an expected comet, and knowing I was anxious to make a study of his head for publication, he washed his face, and with his shirt off, posed till I made the study. Then with a cheery good-bye, we left in a wagon for Rahway, having missed the train; the plaster man hugging his mold. Later, when it was finished, it showed the mouth twitched to one side—the effect of the surprise felt when I grasped his hand before the plaster had set."

In 1881 Mr. Edison was deprived by death of his wife, the intelligent and sympathetic companion of his early manhood, and the mother of his first three children. His sorrow was deep-seated and genuine, but work, as well as time, is a wonderful panacea for human troubles, and the inventor owed too much to public life to indulge in the luxury of private grief. He was soon ardently engaged in the fruition of his multifarious schemes, many of which demanded a considerable amount of migration. In the development of the machines for generating electrical power Edison established himself at Goerck street, New York city, in the building formerly known as the Etna Iron Works. A chosen band of followers accompanied him, W S. Andrews, as superintendent of the testing and experimental

department—a position which shortly after devolved upon W. K. L. Dickson, while the other offices were filled by George Grower, H. N. Marvin, Charles Edgar, J. C. Chamberlain and Nicola Tesla. Mr. Andrews proved himself then, as he has since, one of Edison's most valuable lieutenants, and his executive skill, gently yet forcibly exercised, went far toward smoothing the path of his successor. Mr. Edgar, now manager of the Boston Edison Electric Light Company, lent his efficient aid in the development of the callow enterprise, and replaced his chief so ably as to admit of many flights on the part of that restless scientist. Mr. Marvin, the inventor of the electric drill, exploited by the Marvin Electric Drill Company, found a congenial field for the exercise of his abilities. Nicola Tesla, that effulgent star of the scientific heavens, even then gave strong evidence of the genius that has made him one of the standard authorities of the day; but like most holders of God's intrinsic gifts, he was unostentatious in the extreme, and ready to assist with counsel or manual help any perplexed member of the craft. Such were the men at Goerck street, and many a delightful symposium comes to remembrance in which these congenial elements took part. Time was not, and surroundings were forgotten, as they listened spell-bound to the emanations of Tesla's brilliant intellect, alternately fired with the rapid sketching of his manifold projects, or melted into keenest sympathy by pictures of his Herzogivinian home.

The Goerck street shop was grim of aspect, not over clean, and located in an uninviting portion of the great metropolis, but neither space nor practical appliances were lacking, and the years which antedated the removal of the enterprise to the magnificent establishment at Schenectady, in December, 1886, were years of brilliantly successful, if anxious, thought. Edison's experimental work on the dynamo was tinged with a daring which went far towards neutralizing the monotony of the proceedings.

BY KIND PERMISSION OF W. J. JENKS

EDISON AND HIS ASSISTANTS AT MENLO PARK IN 1880.

On one occasion a force of men was engaged in testing a new type dynamo, which had been greatly reduced in size, and was giving more light than was anticipated. Mr. Edison was so pleased by this unexpected electrical energy that he started on a series of tests to discover how high the dynamo could be run without flying into pieces—not that that trifling contingency would have been an obstacle to investigation. When the capacity of the machine had been reached, the order for more steam was given in the usual classical terms: "Fire up, men, let her go." At first we stood round at a respectful distance from the dynamo, but as this began to exhibit signs of ferocious activity, we became interested in side expeditions to a large and solid brick building, attached to the shop, where Mr. Edison awaited reports. The climax finally came in the shape of a deafening roar, which heralded the bursting of the main steam pipe, leading to the engine. Nothing worse occurred, at least nothing resulting in loss of limb or life, but it was a lively experience just the same. However, the demonstration was scientifically complete, from Mr. Edison's standpoint, and what mattered a few collateral damages.

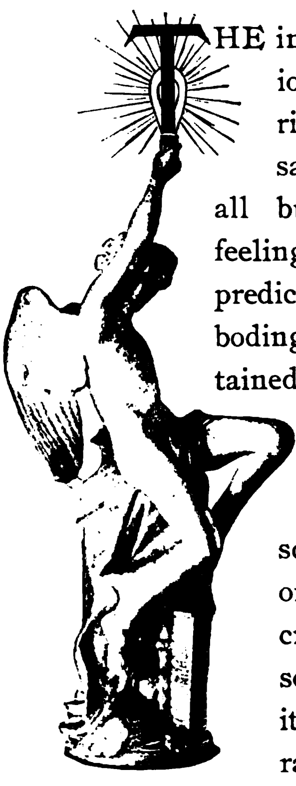
The beds were more original than luxurious, and generally consisted of a table or bench, with galvanometers and resistance boxes for pillows. But revenge was obtained once in a while, upon the author of these miseries. One night, after an exasperating vigil of many hours, one of the boys conceived the brilliant idea of putting the clocks several hours ahead, so as to induce the slumbering chief to quit work a little earlier. On awakening, after one of his cumulative naps, Edison found, to his amazement, that it was 4 A. M. and gave the order to stop for that night. He was puzzled to discover that his watch, usually so reliable, should be a laggard to the tune of six hours, and was still more astonished, on emerging into the streets, to find many of the theatres emptying themselves. Then it was

that he realized the nature of the joke perpetrated, and indulged in a hearty and unresentful guffaw.

Curious indeed were the types of humanity which were attracted to Goerck street. One morning Edison sent word to prepare for the coming of Sitting Bull and his tribe, and after an animated scuffle of two hours, everything was ready to receive the distinguished guests. At the appointed time they arrived, sitting in all their war paint and grotesque bedizenment on the top of several omnibuses and carriages. Stolidly they surveyed matters from their elevation. Stolidly they descended and stalked through the establishment, betraying by neither word, sign, nor look their appreciation of the unusual surroundings. Edison's sense of fun was roused by their behavior, and shaped itself into a practical joke, which will doubtless be long remembered in that quarter. He ordered one of the dynamos to be stopped, ran a wire, heavily insulated with cotton, and attached it by both ends to the generating machine. He then stationed the Indians close to the wire, which ran the full length of the main shop, and watched their faces closely, while the metallic thread was getting red hot. No interest was evinced until the burning cotton rose in a cloud, and filled their eyes with the stinging incense, when a loud "hugh" was heard, and much vigorous rubbing of the eyes ensued. Edison got some of the burnt cotton in his eyes, but the success of his experiment consoled him for this trifling casualty.

CHAPTER XVIII.

INTRODUCTION OF EDISON LIGHT. TRUE NATURE OF EDISON'S CLAIMS. PUBLIC EXHIBITIONS. PRACTICAL AND FANCIFUL APPLICATIONS OF LIGHT.



THE introduction of Edison's lamp, with the superior claims made for it by Mr. Edison, gave rise to a tide of abuse, detraction and stinging sarcasm, such as inevitably falls to the lot of all but safe mediocrity. The waves of public feeling rose and fell, scintillating with brilliant predictions, or darkened by clouds of gloomy foreboding. Among the men of the time who entertained pessimistic ideas as to the ultimate success of the incandescent light, was Professor Morton, of Stevens Institute of Technology, who embodied his views in a dismal and scathing lecture, delivered before a large body of the initiate and uninitiate. These adverse criticisms called forth Edison's assertion, that some day when the Edison light had attained its apotheosis, he would erect a statue to this raven of science, inscribed with the words: "This is the man who said the Edison light would never work," framing the statue in the perfected effulgence of the new illumination. Among the many poisoned shafts winged at Edison, was the oft-repeated asseveration: "No line of original discovery marks the electric light. Long before the days of this presumptuous claimant, the vexed problem of incandescent electric lighting had received practical solution at the hands of our best scientists."

GLASS FURNACES FOR LAMP MAKING.

Mr. Edison at no time has ever advanced a claim of original discovery in connection with the electric light, but he does claim, and with undeniable justice, that in his hands the immature and scattered principles of his predecessors were perfected, and welded into one symmetrical whole. In his hands the incandescent electric light was withdrawn from the fruitless seclusion of the laboratory, and transferred to the plane of practical utility. From a costly toy, interwoven with intricate mechanical difficulties, and gifted with but a limited period of existence, it has become an all-important factor of public life, embodying the features of evenness, power and inexpensiveness, which were so conspicuously lacking in former systems. Not that we would deny the indispensable basis afforded by prior investigations, or the undeniable talent and energy displayed by former scientists—on the contrary, we are disposed to admit, in a large measure, the self-evident proposition advanced in our question. At the same time it may be maintained, that the

very excellence of these methods enhanced the difficulties of Edison's task, and threw into broader relief its superior merits.

The first public exhibition of the incandescent electric lamp was given in the winter of 1880, at its birth place, the inventor's laboratory in Menlo Park. Visitors flocked from every portion of the United States, impelled by commercial or scientific interest, and their numbers were so great as to necessitate

BLOWING A LAMP BULB.

the introduction of special trains on the Pennsylvania Railroad, between Jersey City and Menlo Park. The plant comprised about 700 lights, which were distributed in the most effective manner throughout the grounds, the streets and the internal arrangements of the Edisonian metropolis. The majority of the

A GROUP OF GLASS BLOWERS.

conductors were laid underground in much the same manner as gas, and a public demonstration was thus afforded of Mr. Edison's claims in regard to the feasibility of commercial lighting which won the confidence of the most cautious capitalists, who forthwith besieged the inventor with schemes for the extension of his methods, many of which were eventually carried into operation. The notoriety afforded by the Menlo Park Exhibition had a most stimulating effect on the new company. The stock rose to $3000 a share, although its par value had originally been only $100, and newspapers and visitors competed in the circulation of the new methods.

An amusing scientific dispute, born of the Menlo Park achievements, arose about this time, as to the nature of an extremely brilliant light which appeared in the western heavens overhanging the hamlets of Rahway, Ramapo and Suffern. Suf-

SEALING LAMPS.

fern boasted of a schoolmaster whose word was law on all disputed points of erudition, and whose faculties had largely been enlisted in following up Edison's experiments with the electric light. He had been one of the interested spectators on the occasion of the Menlo Park illumination, and had returned to his native haunts more impressed than ever with the effulgence

of Edison's genius, so that when the mysterious luminary sparkled on the darkling brows of the Ramapo Mountain, and society fell into a dispute as to its nature, he promptly decided

FINISHING A LAMP BULB.

it to be an electric light. Edison was just now engaged in experimenting with an electric light and a balloon, at Menlo Park, distant forty miles—so the gaping audience was informed —the object being to ascertain how long that special phase of illumination could be induced to burn in the upper regions of

the air. Upon the successful outcome of this test hinged important issues, the system being before the consideration of government in connection with the signal service and coast lighting. To this oracle, the justice, doctor and storekeeper—minor potentates of Suffern—gave their unqualified assent, the only dissenting voice being that of the village postmaster, who referred the new phenomenon to an astral source, and detected a suspicious family resemblance to Venus. He was swept aside, however, by the tide of public opinion, and the new appearance was definitely registered as the product of Edison's brain. Many tributes have been laid at the inventor's feet, but none which could vie with the above in absolute naïveté of admiration.

The new Edison incandescent lamp of 1881, while falling short of its present perfection, was sufficiently advanced to admit of an extensive display at the Paris Electrical Exposition, on which occasion Edison was the recipient of five gold medals and a diploma of honor, the highest distinction conferred upon any exhibitor. The following cable message was received by Edison from the official headquarters of the Exposition:

"Official list, published to-day, shows you in the highest class of inventors. No other exhibitor of electric light in that class. Swan, Fox and Maxim receive medals in class below. The sub-juries have voted you five gold medals, but General Congress promoted you to the diploma of honor. This is complete success, the Congress having nothing higher to give."

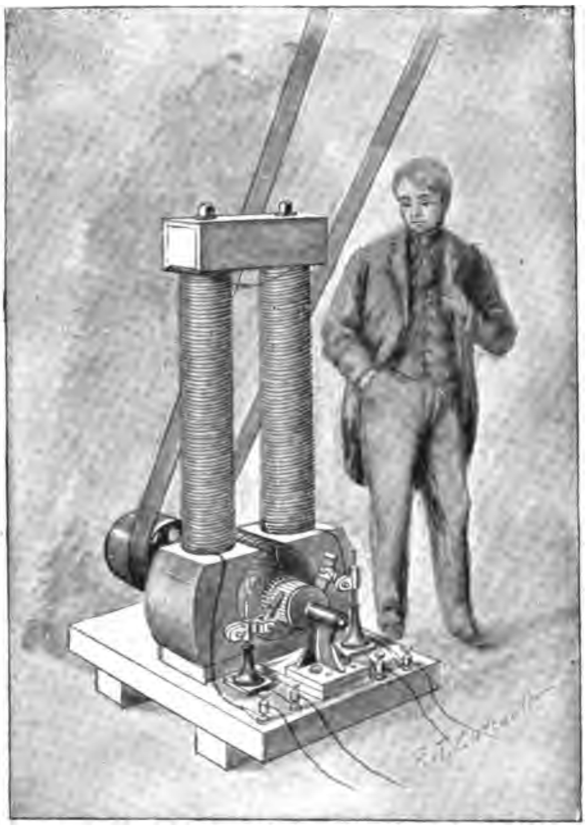
Professor Barker, of the University of Pennsylvania, who was present at the Exposition, telegraphed Edison in the following terms: "Accept my congratulations; you have distanced all competitors, and obtained a diploma of honor, the highest award given in the Exposition. No person in any class in which you were an exhibitor received a like award." The third telegram sent Edison on this occasion was perhaps the most interesting, as reflecting the magnanimity and cordial appreciation of a rival

competitor. Swan, the proprietor of the Swan incandescent light of England, cabled as follows: "You have received the highest award the jury has to give. I congratulate you."

"Nothing succeeds like success," and the new system spread like wild-fire. The distinctions conferred by the Paris Exposition were only the prelude to many public recognitions of Edison's pre-eminence. Among the different systems, employed in the Crystal Palace Electrical Exposition of London, on the following year, Edison's attracted universal attention. Its happy blending of mellowness and strength, like the soft brilliancy of Andalusian eyes, lent itself to the most varied effects. From the glittering coronal of frozen loveliness—meet diadem for the Scandinavian Frost giants—which overhung the concert-room of the Palace, to the tinted fires which glowed in the heart of fountain, flower and sward, the eye was intoxicated with beauty. The entertainment court was canopied with a chandelier of the most exquisite design, the work of Messrs. Verity & Co., gathering into itself the floral magnificence of a hundred favored climes. Metal and colored glass combined in the reproduction of nature's softest and richest hues, and a tiny spark, concealed among the petals, or nestling beneath the folded leaves, brought into relief each delicate curve and vein. Three hundred and fifty of these fairy blossoms were represented, ranging from the sunflower, the narcissus, the tiger-lily and the orchid, down to the modest clove pink, the whole enshrined in a basket of hammered brass. Ninety-nine Edison lamps, in three circuits, were employed, the brass stems of the flowers being hollow, so as to admit of the passage of the wires. A miniature model of this chandelier, or electrolier, as our newly revised dictionary has it, was presented by Mr. Edison to the Prince and Princess of Wales. It bore the following inscription: "A Souvenir of the visit of their Royal Highnesses, the Prince and Princess of Wales, to the Electrical Exposition of the Crystal Palace, 1882, with the

compliments of Thomas Alva Edison." Electricity was stored within the recesses of the bouquet, so as to be instantaneously brought into play or extinguished.

What more superb tribute was ever laid at the feet of Den-



AN EARLY EDISON DYNAMO, 1880.

mark's Rose? Ah! potent wizard, you shame the records of the Arabian nights, and the fabled glories of the east. We must look from these to the pictured paradises of the blest, where the gems are lit by deathless fires, and where fountains and foliage give forth Eternal harmonies.

THE FIRST INCANDESCENT CENTRAL STATION IN THE WORLD.

Appleton, Wisconsin, 1882--One Dynamo, Fifty Lights.

The Edison exhibition was not limited to these decorative effects, but brought into view every domestic exigency to which this luxury-loving century has given birth. The plasticity of the Edison incandescent system, the steady, potent and mellow radiance of the lamp, and its exemption from the splutter and glare which characterized the arc light, excited universal comment, and elicited even from the cautious and conservative British press the tribute of an unwilling admiration.

"The palm is undoubtedly carried off by the Edison show, which is extremely beautiful," remarked one periodical. "Mr. Edison's splendid show in the Concert Room and Entertainment Hall continues to attract more attention than any other,"—

observed a second. The *Illustrated London News* commented feelingly on the soft, delicious radiance diffused by the Edison lamp, and admitted that its soothing influence had totally neutralized the popular objection to electricity for internal illumination. It concluded by emphatically pronouncing the Edison exhibit to be "unique and well meriting the encomiums bestowed upon it." Equally important and conclusive results were achieved in succeeding Exhibitions; notably those held at Munich in 1882, at Vienna in 1883, Philadelphia in 1884, Paris in 1889, and at Minneapolis in 1890.

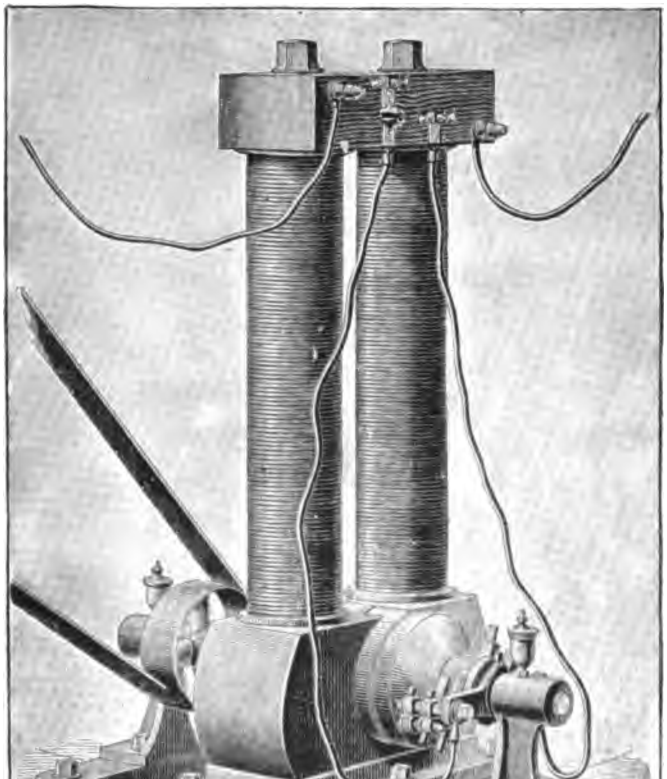
Electric lighting formed a prominent feature of Edison's exhibit in the Paris Exposition of 1889. Nine thousand feet were allotted to the inventor, in view of the unusual magnitude of his contributions to experimental science, and this space was filled to overflowing with the varied fruitage of Edison's ripened thought. In the centre of this unique display was an enormous model of an incandescent lamp, forty feet high, the globe constructed of no less than twenty thousand incandescent lamp bulbs, sc brilliant as to illuminate the entire expanse of the main building. On either side of this concentrated effulgence were ranged the French and American flags, composed of colored incandescent lamp bulbs, the jewelled effect of which recalled the glories of Aladdin's magical cave, or the fabled wealth of Sinbad's valley of gems.

A dynamo of enormous proportions, the ripened outcome of over ten years of experimental work in electrical generators, occupied a central position among this luminous efflorescence, like Vulcan among the Loves. In the construction of this and kindred machines, Edison has employed massive field magnets, in place of the extremely light ones, utilized in the immature stages of electrical illumination, thus securing an efficiency undreamt of by his predecessors. In a series of charts, suspended against the walls, might be traced the wonderful evolu-

tion of this machine, from the first rude generator, consisting of an electro magnet, before which a gigantic tuning fork was made to vibrate, through the gathering perfections of later forms, heralded by that known as type Z, having a capacity of sixty 16-candle power lamps. Several of this type machines were used as the source of current for the seven hundred lamps which sprang into simultaneous birth in the buildings at Menlo Park. This class of machine is shunt-wound, the magnet spool cores being considerably longer than those in present use. In succeeding diagrams, the gradual increase of the number of magnet cores in parallel is shown, commencing with four-spool cores, and extending to six-magnet cores in parallel. At this point the inordinate length of the magnets, and the undesirability of grouping together so many parallel windings forced themselves on Edison's attention, and led to the curtailment of their length, and the increase of their sectional surface, features embodied in the perfected dynamos of the day.

Prominent in this graduated series of electrical generators was the famous "Jumbo" dynamo, constructed in 1881, first seen at the Paris Exhibition of that date, and afterward exhibited at London, Milan and New York, where its daring innovations on the accepted groove of ancient methods were already sufficiently startling to excite considerable popular wonder. An allegorical picture was also displayed, entitled "Menlo Park, the birth place of the Incandescent Lamp," and a series of charts was exhibited, representing the more prominent buildings of the world which have adopted the Edison methods of lighting, together with illustrated statements of the nature and extent of Edison's methods for disseminating light and power. These, at the time of the Paris Exposition, demanded no less than seven hundred miles of underground conductors in the United States alone. The Exhibition also embraced every auxiliary appliance utilized in the production of the electric light,

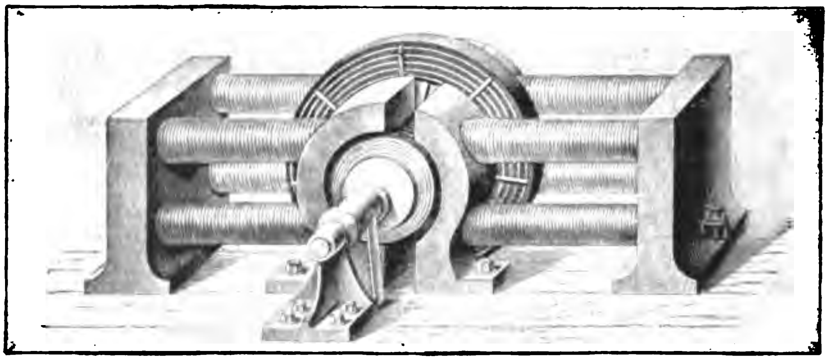
such, for instance, as the Edison meter, the outcome of careful experiments in connection with all varieties of clock-work, motors, electro-magnets and springs, heat, electrolysis and



ANOTHER EDISON DYNAMO OF 1880.

electro deposition, and designed to register the amount of current furnished to consumers.

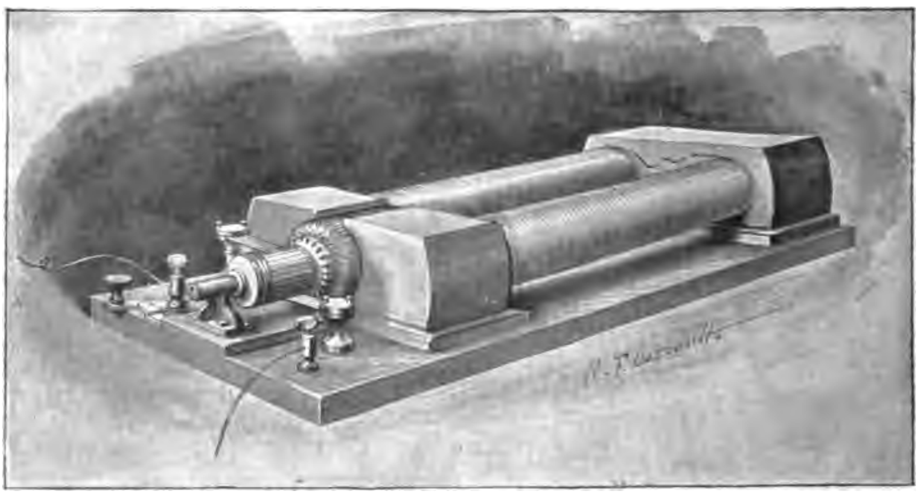
In reviewing Mr. Edison's achievements in these different



PLATING DYNAMO OF 1881.

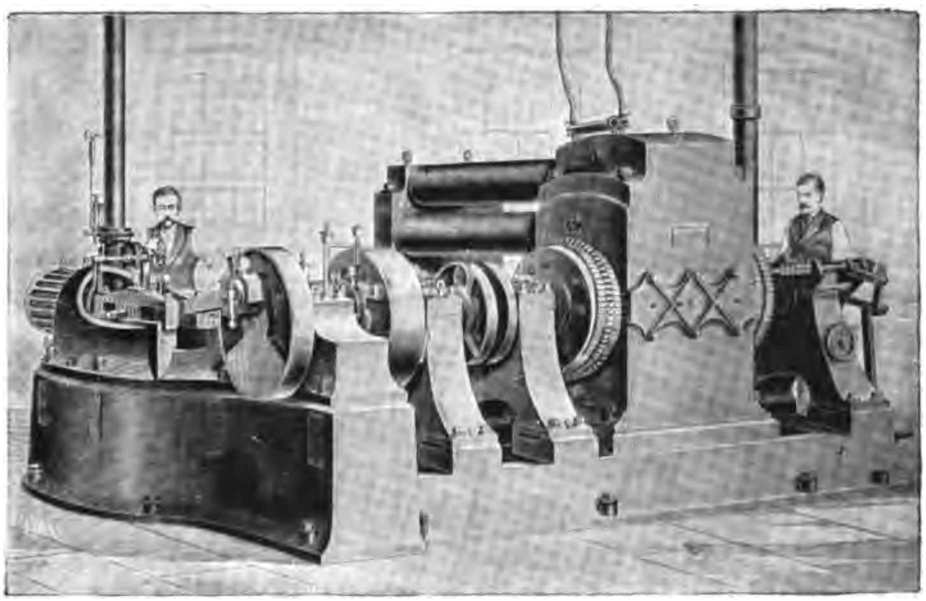
fields, with special reference to the Paris Exhibition of 1889, The New York *Tribune* takes occasion editorially to remark, under the caption of "An American Abroad":

"While emperors and queens are receiving the highest honors and the lavish entertainment within the province of royalty, an American has commanded a characteristic welcome. This is Edison, whose genius commands the homage of Paris,



EARLY FORM OF HORIZONTAL DYNAMO OR MOTOR.

London and Berlin, one of the most modest and unpretentious of men—not even Franklin had more marked simplicity of manner; he has been received in the preoccupied and distracted French capital as one of the wonder workers of the modern world. . . . America could have in Europe no worthier representative of the consummate flower of its National life and progress than this modest scientific investigator. Its



AN EDISON DIRECT CONNECTED GENERATOR, 1881.

chief contribution to the world's stock of civilization have been the works of its inventors. In that beneficent field of human effort, its sons are unrivaled for practical skill, habits of scientific investigation and triumphs of mind over material forces. While the European continent to-day is a circle of camps swayed by the caprice of sovereigns whose inherited functions are their only title to fame, America has expended its energies in working out an industrial development that is the marvel

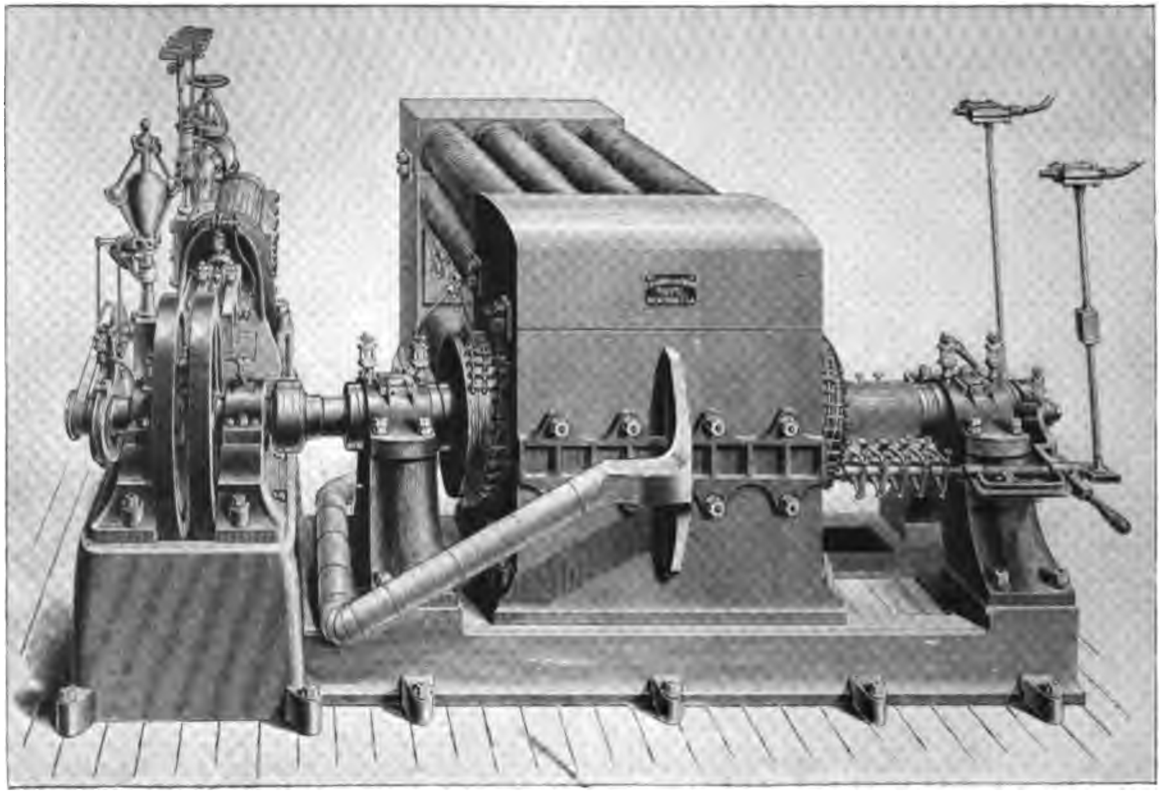
of Christendom, and the real leaders of its pacific progress have been, and are, its inventive mechanics—men of the Edison stamp."

Mr. Edison made no personal exhibit at the Columbian Exposition of 1893, but he was largely and variously represented by the numerous companies operating under his patents. An interesting feature in the exhibition of the North American Phonograph Company was the greater part of the inventor's collection of medals, awards, diplomas, decorations and autographic letters. Prominent among these was the Albert medal, awarded to Mr. Edison in 1892 by the Society of Arts, through its President, the Prince of Wales, and accompanied by an autograph epistle from the genial heir to the British throne. After recalling the fact that the medal was instituted thirty years ago in honor of the Prince Consort, since which time it had been conferred exclusively upon men of international scientific distinction, the Prince adds:

"It is a source of satisfaction to me that the last name on this distinguished list should be that of one who has done so much for the advancement of science as yourself."

The British Minister, Sir Julian Pauncefote, in forwarding the medal, expresses his personal gratification in according the tribute "to one whose inestimable benefits have been conferred on all nations."

Under the fostering auspices afforded by these public expositions the Edison incandescent light became extensively introduced, in connection with public squares, buildings, etc. The commercial strides of the new industry were no longer to be impeded by the feeble barriers of international prejudice, and England, yielding to the infectious example of her sister powers, repealed in 1888 the Parliamentary law enacted in 1880, providing that all electric light plants should, at the expiration of twenty years, pass into the possession of the



THE EDISON JUMBO DYNAMO, 1881.

Government. To the crippling effects of this edict had been largely due the stagnation of electrical industry in Great Britain, but the remedial measures were attended by an instantaneous revival of interest, and to-day there is not a hamlet in England, however insignificant, which is not in vital connection with the central sources of supply.

Long before the tardy concessions of the Isles, electricity had established her brilliant sway among the dim regions of romance. The soft gloom of Oriental bazaars, with their perfumed and mysterious recesses, the sculptured avenues of colossal temples; the quaint strongholds of mediævalism; the primitive structures of rude and uncultured races; these were brought under the new dominion, and despoiled of such lingering fragments of mystery as had been spared by the march of time. Nor were the new laws exemplified on the surface of the earth alone. The Edison incandescent lamp lent itself with peculiar felicity to the work of miners and divers, being potent, steadfast and innocuous—three indispensable attributes, when we consider the density and gloom of the atmosphere, the delicate nature of the operations and the perilous isolation from human help. Within the range of human vision came unguessed miracles of underground architecture, wrought by patient hands in the gloomy recesses of the world; gems of "purest ray serene" yielded their shrouded loveliness; palaces floated on the waters of bay and ocean, recalling the splendors of lost Atlantis, miracles of submarine life flashed into view, fretted spires of coral, rose-hued and ivory, beds of translucent and palpitating flora,

> "In the purple twilights under the sea.
>
> . . . .
>
> Broad sea wolds in the crimson shells,
> Diamond ledges that jut from the dells,
> Turkis and agate and almondine."

CHAPTER XIX.

GROWTH OF LIGHT AND POWER INDUSTRIES. DECORATIVE EFFECTS OF INCANDESCENT LIGHT.

STIMULATED by public appreciation, the Edison industries steadily gained in strength and magnitude. The European Company was organized in 1882, plants were established in important trans-atlantic centres, and the Edison London Company sprang into existence. On this side of the Atlantic, the commercial statistics were even more encouraging. The impetus originally given by the Menlo Park Exhibition had gathered momentum with each succeeding day, and the modest premises of the Edison Electric Light Company were no longer in keeping with the extent of the ripening enterprise.

The extension of factories enlisted a large amount of Mr. Edison's personal attention. Of these, the Goerck street shop at New York was the initial enterprise, supplemented by the establishment at 65 Fifth avenue, so dear to the hearts of Edisonian veterans, and flanked by a smaller lamp manufactory at Menlo Park, together with auxiliary establishments for the purpose of promoting underground tubing, an important outcome of the system, incorporated under the name of the Electric Tube Company, and of which the city of Brooklyn furnished the first harborage.

In laying the first Metropolitan telephone wires under ground on the Edison anti-induction system, each tube con-

tained from two hundred and fifty to four hundred wires. At every twenty feet a box was placed for the purpose of breaking up the induction, which was done by separating the wires, and not allowing them to remain side by side in the next length of tubing. This was contemporaneous with the administration of Mayor Grant, of New York city, which rendered itself conspicuous in the ensuing year by requiring the removal of all overhead wires.

The demand for isolated plants was steadily on the increase, heralded by the installation of the first commercial incandescent lighting plant in the mill of James Harrison at Newburgh, N. Y. So extensive and widely segregated were the demands for isolated plants, that it was found necessary to create a separate company for the sale and supervision of these industries. This organization was launched in 1881 under the title of the "Edison Company for Isolated Lighting." A common source of creative energy was supplied to these isolated plants by the establishment in 1882 of the Pearl Street Central Station at New York city, with fifty miles of conductors and 2000 lamps. The practical workings of the Pearl street station were remarkably facilitated by Edison's invention of the three-wire system, and the central business was rapidly extended into a number of auxiliary stations.

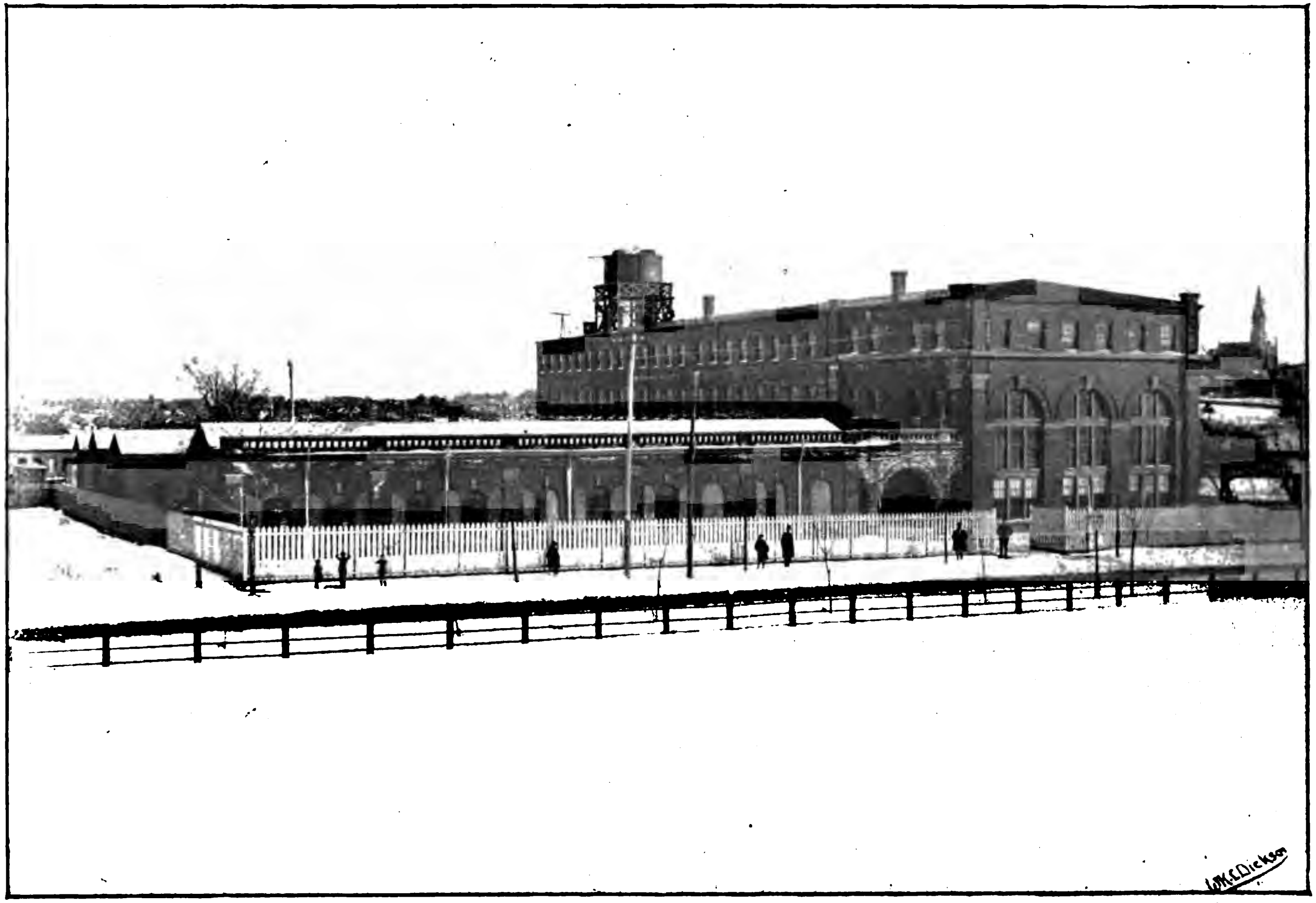
The Goerck street shop expanded with its growing necessities, and signalized its rise in the social scale by the assumption of the more imposing title, "The Edison Machine Works." A large factory at Newark, N. J., became the birthplace of the "Edison Lamp Company," a corporation formed for the purpose of exploiting the completed lamp, and extended later into the "Lamp Works of the Edison General Electric Light Company," at Harrison, N. J.

Marked prosperity has attended the Newark enterprise, which is in existence at the present time, its capacity amounting to over 25,000 lamps per day.

Sigismund Bergman & Co., makers of electrical instruments, held a license from the company, embracing the manufacture of sockets, fixtures and similar appliances, and under their energetic management the factory at Avenue B and Seventeenth street, in New York city, was added to the business, with a force of several hundred hands, afterward increased to over a thousand, and backed by the important establishment at Twenty-seventh street and First avenue. In 1886 the Edison Electric Light Company and the Edison Company for Isolated Lighting consolidated under the name of the Edison Electric Company, an offshoot of which was supplied by a coalition of manufacturing interests known as the Edison United Manufacturing Company, an organization resembling the old Isolated Company, but gifted with influence and territorial powers immeasurably in advance of its predecessor.

Still the course of public events pointed to the necessity of a supreme and central focusing point, which was attained in 1889 by the consolidation of the various light and power industries under the title of the Edison General Electric Light Company, with a capital stock of $15,000,000 and a gross annual business of nearly the same amount. From the parent stream, represented by the magnificent headquarters of the organization in Broad street, New York city, radiate, among many others, the following giant tributaries: The numerous buildings for the exposition of the completed lamps and fixtures located on Fifth avenue, the colossal factories in the different portions of the same metropolis, the branch offices in Boston, Chicago, Toronto, San Francisco, Portland, Denver and Atlanta, and the enormous manufacturing centres in New York State, notably the important establishment at Schenectady, together with the buildings in Harrison, N. J., and Peterborough, Ontario.

In the year 1891 the parent establishment on Broad street, New York, gave employment to hundreds of clerks, comprised a



THE EDISON LABORATORY AT ORANGE, N. J.

list of 600 paying customers, and exhibited a monthly income and expenditure of $1,000,000. Ten million dollars was the showing of the last fiscal year in the way of aggregate business accomplished, and $4,000,000 are frequently embodied in the raw material in process of use. The aggregate of the Edison stations, large and small, embraced in 1891 the enormous total of 1,371,000 lamps, exclusive of the colossal amount supplied by the isolated plants, several thousand of which exist, with a capacity of from 5000 to 10,000 lamps, and necessitating many thousands of horse-power for car service alone. The electric railway department is represented by sales amounting to 27,679 horse-power of motors and 22,836 horse-power of generators in a single year, to say nothing of the multifarious uses which electricity affords, such as mill plants, mining outfits, electric elevators, dynamos for supplying telegraphic currents, stationary motors of different sizes and appliances. These various companies were finally absorbed, along with other companies, into a new organization, known as the General Electric Light Company, that is still operating these different enterprises.

A more interesting pilgrimage for devotees to electrical science could hardly be imagined than that afforded by a survey of the different industries, where the evolution of the incandescent light may be minutely traced from its first mystic birth, through its successive avatars, until it attains its apotheosis in the artistic creations of the perfected lamp. With the crystalline bulb enshrining the luminous filament we are all familiar; few, however, have gauged the beauty and variety which have found embodiment in the setting and fixtures. These are indescribably lovely and lend themselves to every style of architecture, from the buoyant charm of a Louis Quinze salon to the mournful splendors of a Moorish palace. In one of these felicitous reproductions the ceiling of the banqueting hall is inlaid with arabesques of tinted crystal set in beaten gold, mel-

low bronzes and frosted silver; and a multitude of incandescent lights concealed within the gems, calls forth a kaleidoscope of prismatic rays. In another of these enchanted abodes, on the occasion of a bridal feast, a central group of wrought silver represented a gondolier plying his bark through a sheet of mimic water. By some automatic and synchronous arrangement, invisible to the spectator, the electric spark flashed to the edge of the oar whenever this was lowered into the waves, producing the exact effect of that phosphorescent radiance which the ocean emits.

At Mr. Edison's sumptuous residence, "Glenmont," of which more hereafter, and on the occasion of a juvenile party in honor of the inventor's daughter, Madeline, numerous incandescent bulbs, stained in a variety of exquisite colors, were concealed among the crystal fringes and stalactites of the great chandeliers, and connected in such a fashion with the sources of electrical supply, as to throw out, one after another, sheets of emerald, ruby, sapphire, amethyst and gold, after the manner of the illumination of St. Peter's at Rome. In the "Life Cake," a glittering creation of elfin towers and châtelaines, argent foliage and frosted bloom, was enshrined a single electric bulb, which glowed like the famous "Sea of Light" in a setting of minor gems, compounded of a fringe of tiny incandescent lamps not much larger than drops of dew.

On the stage the effects attained are indescribably beautiful. All will remember the presentation of "The Foresters" at Daly's Theatre at New York, the haunting loveliness of those fairy glades, dotted with the glow-worm lights, the starry diadems, the scintillating wands, the changing constellations of tinted fires.

There is scarcely a department in the varied kingdoms of nature and art which does not meet us in our æsthetic pilgrimage. Here the delicate radiance plays

"All round the fragrant marge,
From fluted vase and brazen urn,
In order, Eastern flowers large,
Some drooping low their crimson bells
Half closed, and others studded wide
With disks and tiars."

Here it is dreamily suggested through the silvery spires of coral or the rose-lined recesses of ocean shells. Here, again, it breathes sulphurous through the inflated nostrils of an Eastern Afrite or mediæval dragon. Here, again, its radiance is centred in a lamp which might well be the counterpart of that wonder of the Neronian age, the flying Phœnix of Alexandrian Anthrax, the rose-hued twilight of which lent such an irresistible charm to the beauty of Agrippina. Here, again, emerging from the crepuscular dream of fair women, we are blinded by the effulgence of a Titanic coronal.

"Upspringing arches of translucent pearl
Bedded in frosted argent, richly dight
With roods of starry diamonds, and bound
The brows about with rows of milky fire."

Some of the decorative effects attained in the various exhibitions have already been touched upon, and, in this department, Mr. W. J. Hammer, the electrical expert, has displayed an ingenuity which would fit him for the post of terrestrial representative to Queen Mab. The latest of these electrical caprices sprang from the fanciful genius of Mr. Luther Stieringer, and was one of the most popular features of the World's Fair at Chicago. It consisted of a stupendous fountain magically colored and illumined. Under the platform of the fountain was placed the propelling machinery, which, to quote the San Francisco *Chronicle*, "consists of a maze of wheels, reflectors, color screens, switch boards, revolving brakes, great water pipes and electrical

apparatus. Above the deck of the fountain are nineteen cast iron nozzles, which all lean slightly toward the centre. Between them and the underground chamber are plates of clear glass, three-eighths of an inch in thickness; underneath each nozzle, and separated from it by the glass, is an electric light. Every one of these electric lights is of 25,000 candle-power. Each is surrounded by a powerful reflector, which throws the light up and colors it as the combinations are made by the color-fans.

The pumps forcing the water have a capacity of 8000 gallons a minute, or 12,500,000 gallons a day; that is two-thirds of the quantity necessary to furnish water for a daily supply to San Francisco. These pumps force the water into pipes thirty inches in diameter. There are 500 feet of these pipes and every inch is worth a dollar. They enter the lower chamber of the fountain and are distributed to the different nozzles. In these nozzles there are 500 jets of all sizes. With them, fifty different combinations may be made. These nozzles are above the glasses described. Four men are required to operate the fountain. One is stationed at the pumps in the Mechanic Arts Building, another in the lower chamber of the fountain, a third manipulates the color screens, and a fourth is on the towers of the Mechanic Arts Building. The switch board is connected by electric wires with the tower station and the pump room. The man in the tower signals what he wants and the man at the switch board obeys him. By this switch the colors may be changed every twenty seconds and the water quite as quickly. The nineteen nozzles are arranged in an elaborate manner. In the centre is the great geyser, surrounded by six smaller ones containing 100 small jets one-fourth of an inch in diameter. These jets may be made to spray if necessary. In the next outer circle is a series of nozzles which give the curtain effect to the water. Outside of them are ring jets, and the next series is of twelve jets, which are called parabolas, and whose strength is toward the centre.

In the next circle are twelve vertical jets called pulverizers. The last circle is of spiral jets, twelve in number, which give the effect of sheaves of wheat. . . . .

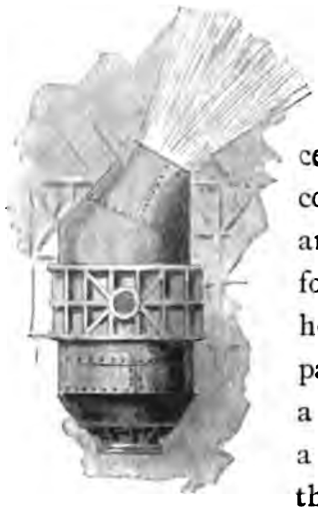
"This fountain represents perhaps the most elaborate and startling application of electricity ever made in an endeavor to secure beautiful effects, and has been contrived by a man who has won world-wide fame for his success in this line."

And now let us take our places with the sightseers in the grand court of the Exposition.

Outlined against the "Night's Plutonian Shore," a fountain slowly forms, a magnificent body of water comprising innumerable minor jets, the central sprays rising to the height of some six feet, and tinged with a rich and mellow gold. A deep circle surrounds these, arranged in the shape of wheat sheaves, shot with a delicate and vivid silver. Exquisite gradations of color succeed each other. The central jets become softly suffused with ruby, amethyst, topaz and sapphire; the surrounding wheat sheaves deepen into a burning gold, in which each grain and fibre stands revealed. A great geyser suddenly shoots into the air to a height of some ninety feet. Towards this imperial centre the tributary jets incline, flinging themselves into a riotous ecstacy of form and tint. Another moment and the colors resolve themselves into a sheet of virginal silver, at the heart of which a point of ruby slowly forms, bordered by lavender, gold and green. Inch by inch moves the central flame until the entire expanse is suffused with richest carmine. A pause, and out of the restless play of waters rises a gigantic column, smooth and polished as a shaft of jasper, bathed around its base by a continuous curtain of luminous and etherealized spray. And so on, through undreamt of vagaries of form and tint, until our very identity seems absorbed in the play of the waters, and we fancy ourselves Naiads, Nixies, Undines, anything but fagged and blasé sightseers, "doing the Fair."

CHAPTER XX.

LITIGATION. THE SAWYER–MANN CASE. THE GOEBEL CASE. ENGLISH REVIEW OF THE SITUATION.



As we already have had occasion to remark, Edison's career brought with it the usual penalties of successful genius, but so inured has he become to the counter-currents of jealousy and detraction, and the ebbs and flows of fortune's tides, that he will extract a light-hearted jest from the most virulent newspaper paragraph and peruse the decision of a protracted lawsuit without the moving of a muscle. Some people are launched into this hornet's nest of a world, with never a moral epidermis to dull the force of taunt and inuendo. The physical nerves, that subtle telegraphy of the body, flash the poisoned currents straight to brain and heart, and except the man shelter himself beneath armor from the Prince Immanuel's own treasury, he must needs be done to death by slanderous tongues. Others, again, seem provided with a crustacean coating, in addition to the normal cutaneous equipment, from which the poisoned shafts of injustice glance harmlessly aside. To this order our inventor belongs. His philosophy, inherent and acquired, would scarcely discredit the founders of the Platonic and Stoic schools, and it is the more to be admired, from the fact that it exists side by side with warm affections and a genuine appreciation for the beautiful in nature and art.

As we were saying, litigation, fast and furious, has dogged

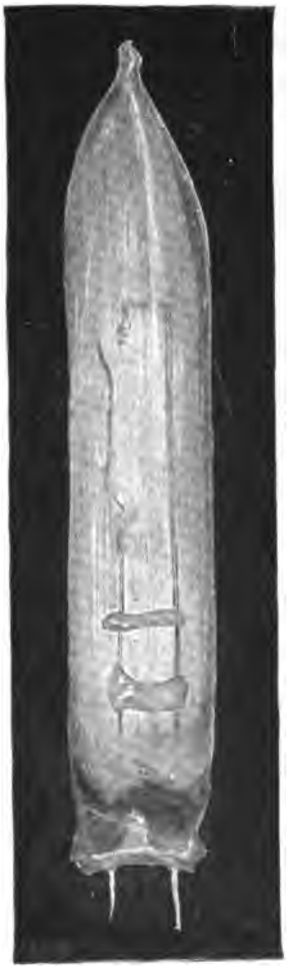
the steps of the inventor. It would tend neither to pleasure nor profit to chronicle the telephonic, telegraphic and illuminating contests in which he has engaged, and in which enormous fortunes have been involved. We will simply confine ourselves to a specimen sketch of the electric light litigation, in connection with which an important decision was reached in 1889. The issue involved was embodied in the broad wording of the patent issued to Messrs. Sawyer & Mann in 1885, claiming the rights over an incandescent conductor for an electric lamp, composed of carbonized fibrous or textile material of an arch or horseshoe shape. The decision at the time was rendered in favor of Sawyer–Mann, but the question was revived with great vigor and acrimony four years later, in the famous case of Westinghouse vs. Edison. In the course of the controversy, which brought under survey the progressive stages of electric lighting and the relative merits of contestants, it was claimed by the defendants that the Sawyer–Mann lamp was inefficient and inoperative, the conductor having been made of a carbonized strip of paper, which immediately burnt out in any vacuum which it was then possible to produce.

The argument was also advanced that the incandescent lamp became a commercial possibility only when Edison invented his subdivided system, and made it not only possible, but necessary, to use, as the incandescing element, a fine thread or filament of carbon. It was claimed, moreover, that Sawyer & Mann were not the inventors of such a filament, and that their lamp, even with a perfect vacuum, could not be used in the Edison multiple arc system of lighting, their conductor being far too large for such use. The gist of the argument was that, inasmuch as the plaintiffs had failed to produce a practical lamp suited to commercial purposes, their patent was not entitled to cover methods which had proved of incalculable benefit to the social and commercial world.

On the other hand, the complainants claimed to be the inventors of the fibrous conductor, the essential and operative feature of the incandescent lamp, and denied the assertion of that lamp's brief duration, claiming that it had been tested and found to burn for 150 hours. In sifting this mass of conflicting evidence and in narrowing down the points of lighting which came within the lines of original invention, Justice Bradley denied priority to the several claimants as regarded the suspended glass globes, popularly known as incandescent lamps, averring that these had been in use in 1845 by King, in 1846 by Greener, in 1852 by Roberts, in 1872 by Konn, and in 1875 by Risloff and others.

The court, moreover, held that the giving of an arched form to the light-making tape or wire within the glass chamber, called the conductor, had received its first application in 1848. The inventive principle under discussion, therefore, and the one to which the patented right would apply, lay in the extreme attenuation of the tape or filament and its enclosure in a perfect vacuum, such as the globe now affords—conditions without which the present perfected incandescent lamp would have been an impossibility. The court, in its proceedings of October, 1889, conceded the priority of the invention to Edison, basing its conclusion on the fact that his patent ante-dated that of Sawyer–Mann by a period of one month. Justice Bradley's remarks contained a lucid presentation of the subject, and an emphatic recognition of the superior practicability of Edison's methods. So conclusive was his summing up, that it would have furnished a permanent settlement to the question, but for the fact that our laws are devoid of that immutability which marked the Median and Persian codes. Successive appeals were made to a scale of graded tribunals, the latest of which confirmed the favorable verdict of 1889.

Scarcely had matters been satisfactorily adjusted in this



SOME ALLEGED EARLY GOEBEL LAMPS.

quarter, when the attention of Edison and his backers was drawn to the formidable claims of a German, Heinrich Goebel, of New York, advanced through the Beacon Vacuum Pump Company, of Boston. This organization, sued by the Edison General Electric Company, for infringement of patent, boldly asserted that lamps, embodying the essential principles of Edison's incandescent, had been in process of construction since 1854, and were the discovery of Mr. Goebel, and that there-

fore the incandescent lamp patent should be considered void, for lack of originality—an assertion which was further strengthened by an exhaustive review of the conditions of electric lighting prior to the issuing of the Edison patent. In this connection, the same ground was traveled over as we find in the suit "Westinghouse vs. Edison," and the claims of prior invention at the hands of Starr, King, Roberts and others, were met as before with the unanswerable reply, that of all this multitude of investigators, Edison had alone succeeded in disclosing to the world a practical, commercial lamp, adapted for domestic uses. In this counter claim Edison was emphatically supported, as before, by the court.

"When," remarked Judge Colt, in the course of his summing up, "we review the literature which preceded this invention, the subtle force with which it had to deal, whose laws had to be intelligently investigated and understood, the well-nigh perfect workmanship necessary in construction, and the slow steps by which the end was finally reached, it seems on its face almost incredible that the incandescent lamp of Edison was, in fact, invented and operated by Henry Goebel, in New York, forty years ago, and publicly exhibited before hundreds of people."

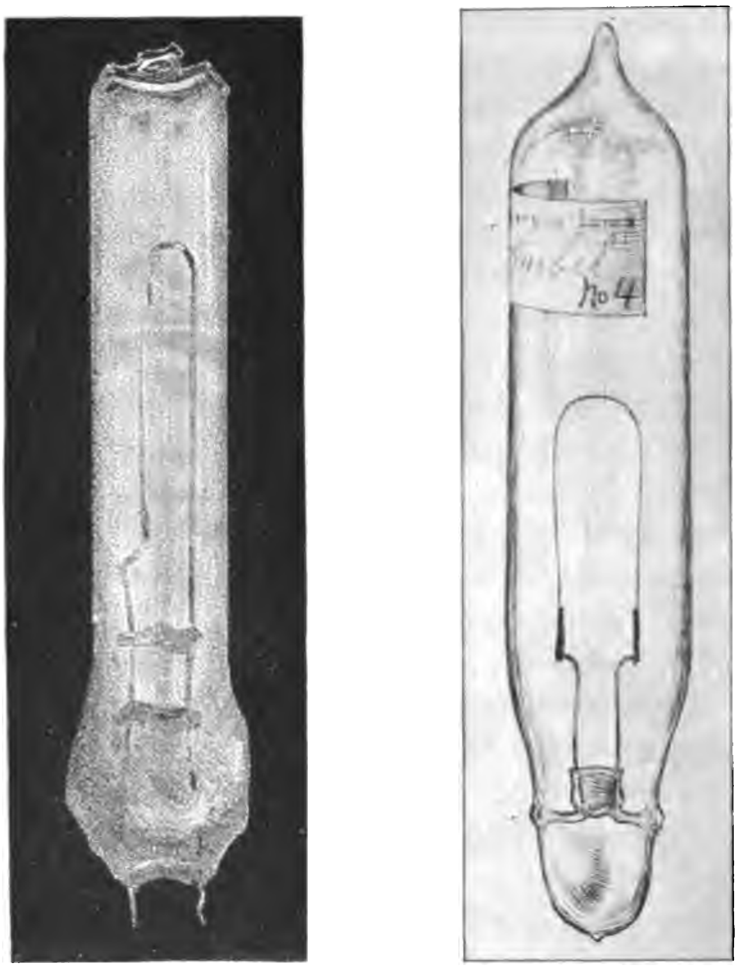
Goebel's story runs thus. A pupil of Professor Munchausen of Hanover, with whom he studied physics, he experimented extensively in the construction of galvanic batteries, and the generation of electric light, in process of which he became exhaustively familiar with the principles of arc lighting, and with the methods employed by Edison's predecessors. Pursuing this line of thought many valuable ideas occurred to him regarding the incandescent light, and he arrived at the conclusion that an incandescent lamp could be produced by a small continuous carbon, enclosed in an exhausted glass tube, hermetically sealed. These principles received practical application immediately upon his arrival in

New York, where he established himself in 1848 as an optician and watchmaker.

The first form of incandescent lamp which he constructed was called a "fiddle bow," and consisted of an exhausted tube, made of glass, in one piece, with leading wires sealed into the enclosing chamber by fusion of the glass. The name is suggested by the shape assumed by the wires with the carbon burner attachment. The next style evolved was termed the "hairpin," from the form given to the carbon. A third shape, presenting carbon and connecting wires in a straight line, was abandoned as unsatisfactory. Leading wires of platinum, iron and copper entered into the construction of these lamps, and the carbons used were made of flax, reed and black cane, one-hundreth of an inch in diameter. Attempts were made to secure perfect vacuum by means of an ordinary air-pump, but these failing, comparatively good results were secured by filling up the tubes with mercury, inverting them, and sealing the ends after expelling all superfluities. Prior to the sealing process, the incandescent conductor had been slightly heated, which, together with a little shaking, caused the mercury adhering to the carbon to fall off. The ends of the leading wires were flattened, then twisted into a spiral tube, into which the ends of the carbon were inserted, and the tubes were then compressed. The joints were generally cemented with heated stove polish, though sometimes the ends of the carbon were electroplated with copper, and an amalgam of gold and mercury was applied to the joints, which adhered to the copper. Sometimes, moreover, a platinum sponge was used for this purpose, the electric current being produced by chemical action from batteries.

Goebel claimed that the utmost publicity was given to the "fiddle bow" and "hair pin" lamps between 1850 and 1880, that these were on exhibition at Cooper Institute, Union square and at his own house in Grand street at New York; that the

principles evolved were original, and that he was in total ignorance of Edison's methods, being debarred from outside communication by his defective knowledge of the English language.



THE FIDDLE-BOW AND HAIR PIN LAMPS.

He further claimed that the merits of bamboo, as a basis for carbons of platinum for leading-in wires, and stove polish as a cement, had been recognized by him, prior to the year 1872,

and that lamps, embodying these improvements, were made and burnt during this period. The existence of the perfected form is based entirely on the evidence of Heinrich Goebel and his son. The other affidavits, some forty in number, embracing the testimony relative to the old fiddle bow lamp, and covering the years ante-dating 1860, emanate from Goebel's friends, and while these may possibly be colored with personal feeling, the character of the witnesses seems trustworthy.

In reviewing the successive stages of the Goebel lamp, Justice Colt drew attention to the earlier form, embodying the ideas contained in Starr's old lamp, with its carbon pencil, enclosed in a Torricellian vacuum, and laid stress on the sudden and suspicious leap from this crude performance, to the comparatively finished form, in which a striking similarity to Edisonian methods is apparent. He discredits the possibility of this lamp having been constructed in 1872, as claimed by the defendants, and enlarges on the suspicious suppression of these claims up to date, despite the many public opportunities afforded. Neither were the superior attributes of the improved Goebel lamp brought forward on other occasions, for instance, when Mr. Dreyer, in the process of organizing a company, procured an option from Goebel, covering all the latter's inventions in regard to electric lighting. For this option the sum of $925 was paid, and it surely stands to reason that if Goebel was at this time in real possession of a lamp invalidating Edison's claims, his suppression of its existence could only be explained by a most remarkable indifference to his own commercial interests. This extraordinary silence was again manifested in later negotiations, and was at total variance with his openly expressed pride in his incandescent achievements, and his very natural desire to realize substantially upon his inventions.

Justice Colt also dwelt on certain additional facts, calculated to weaken the Goebel position. In the suit against the United

States Electric Light Company, instituted in 1885, and again in the Sawyer-Mann Company case of 1892, the Goebel claims entered into discussion, and were ably and carefully investigated, with the result of establishing their utter fallacy. The court saw no reason in the present instance to depart from the decision rendered, and was therefore prepared to grant the required injunction in favor of the Edison Electric Light Company. No combination, however, of "bell, book or candle" has been discovered, sufficiently potent to lay the restless ghost of legality. Even as we write, that indomitable spirit is to the fore, in the revival of the Goebel claims, and there is a prospect of fierce and protracted fighting for all parties involved.

The general obscurity of the legal situation is amusingly portrayed in the London *Electrician*, under the caption of "English Litigation on the Incandescent Lamp," to wit:

"If Edison had no other claim to immortality—and some people believe he is astonishingly well provided in this respect —he still, we think, deserves all the credit which has ever been awarded him for his invention of the definition-defying term 'filament.' The highest available forensic, judicial and scientific skill of this age and country have been brought to bear upon the question, and that not once only, but over and over again, and still, as Judge Cotton plaintively remarked this week, we seem to be no nearer knowing what a filament really is. His Lordship inclines to think that it must be something which 'is formed before carbonization,' but this only serves to show how far a reconciliation of legal subtilties and technical absurdities may remove the final issue from the category in which he who runs may read. For if this be indeed the definition of a filament, then our admiration for the inventor of the term will be more than ever profound."

In April 10, 1892, Mr. Edison sent Lord Kelvin the record of the litigation in the suits to protect the incandescent lamp.

In the accompanying letter he takes occasion to say, "I expect that the already long list of the claimants for the honor of making lighting by incandescence a practical reality will be still further increased as time goes by. Here, in these volumes, however, we have, so far as pertinent in America, the sworn testimony of many witnesses, taken when memories are fresh." Lord Kelvin, in reply, expresses the sincere hope that the result of the litigation "will ultimately be all satisfactory to Mr. Edison, to whom we owe so much for all he has done of benefit to the world, not only in electricity, but in other large departments of inventions."

CHAPTER XXI.

ERECTION OF ORANGE LABORATORY. THE LIBRARY. THE STORE-ROOM. THE LOWER MACHINE SHOP. THE PRECISION DEPARTMENT. THE MERCURY VACUUM PUMP ROOM. THE LAMP TEST ROOM.

THE eighties were pregnant with the crystallizations of Edison's mature thought, with the development of his industries and the recognition of his forceful and versatile intellect. Telephony and telegraphy spread their wide nets over the two continents, the electric light diffused its conquering radiance, the phonograph gathered into its faithful bosom the vocal memories of a thousand climes. Factory after factory sprang into existence, company after company was formed, but still the master mind kept pace with the growing demand. There came a time, however, when the limitations of Menlo Park and its auxiliaries became painfully apparent, and preparations were set on foot for the erection of an establishment which should afford an adequate basis for the development of the inventor's ideas. This was supplied in 1886 by the laboratory at Orange, N. J., a massive and extensive structure, built at the foot of the Orange mountains.

The laboratory consists of a three-story brick building, 250 feet in length and sixty in width. Four smaller buildings are grouped about the main structure, each about 100 x 25 feet and consisting of one story, the whole enclosed by a high substantial fence, and guarded by a gate which yields no entrance, except

PHOTO BY W. K. L. DICKSON
THE EDISON LABORATORY AT ORANGE, N. J.

to a certain recognized "open sesame." Mr. Edison's long and trying record with inquisitive visitors has rendered him less accessible to the general public, and his present views are embodied in a notice to the effect that "Mr. Edison, in justice to his work, is compelled to deny absolutely all personal interviews," to which the addendum is affixed that "No permits can be issued to visitors to enter these premises."

Long-suffering inventor, we would invoke for you the fire-breathing dragon of old, and the castles of adamant, did we not know that in your mysterious sway over nature's forces, and in the tried affections of your henchmen, you possess better safeguards than anything mediæval superstition could supply! It will doubtless afford satisfaction to the injured public to learn that Edison himself fell a victim to his own devices, as many an ingenious schemer has done before him, the great inventor being denied admittance at the hands of a novitiate gatekeeper, who kept him at bay until identified by some one more familiar with the chief's appearance.

The "open sesame" having been furnished to the implacable warder at the gate, we are admitted into an aggregation of wonders which, but for our fatal nineteenth century satiety,

would seem far more marvelous than the treasures of Ali Baba's cave. As an exposition of the genius of many minds, it would be fraught with vital interest and worthy of sincere admiration; but as the outcome of one man's brain, and that man no darling

PHOTO BY W. K. L. DICKSON

A CORNER IN THE LABORATORY LIBRARY.

of fortune, but a hard working son of the people, the results are surely unique.

We are ushered first into the library, a spot so palatial, so luxurious, that to the pilgrims of science it contains a subtle suggestion of the arbor on the hill. Our senses are too fully in demand, however, to yield to these soft seductions, and with an effort we resist the enervating influence of divan and arm-chair, and wander through the enchanted ground, wary of eye and limb.

Of royal dimensions is the library of that extraordinary man, whose youthful elbows often suffered from involuntary contact with the walls, and whose restricted quarters suggested Miss Mitford's bedroom, where, without getting out of bed, it was possible to light the fire, shut the door and open the window. The library is forty by fifty feet, vaulted by a ceiling forty feet high and encircled on three sides with graceful carved galleries, supported on pillars of iron. Book-cases of rare and beautiful polished wood adorn the sides of the hall, and as we pass, glimpses are afforded of ancient and modern tomes, the rich fruitage of every scientific clime, from the sparse blossoms of early Greece, Arabia, Central and Northern Europe to the golden vintage of the present age. These literary treasure houses contain fully 40,000 works of reference, and are so formed as to constitute alcoves both on the lower floor and on the successive tiers of galleries. An Oriental flavor is imparted to the surroundings by a bank of flowers and palms, and a touch of refined and imaginative art is given by Bordiga's celebrated marble statue, "The Genius of Light," purchased at the Paris Exposition of 1889, by Mr. Edison, and representing a winged figure poised on the shattered remnants of a gas lamp, while in its right hand it holds a brilliant incandescent lamp. Portraits of prominent scientists adorn the wall, flanked by busts of well-known naturalists and electricians, together with a series of semi-allegorical designs, representing the triumphs of the incandescent light.

Models of dynamos and terrestrial globes meet us on every side, diversified by an electrical organ of rich and sonorous tone. We resist these seductions, one and all, despite the tempting lounges and chairs which invite to luxurious contemplation, but no combination of circumstances short of wild horses or a blizzard could induce us to slight the exquisite Tiffany-Kuntz collection of minerals and gems purchased by Mr. Edison at the

Paris Exhibition, and which holds its glittering court in the recesses of the first gallery.

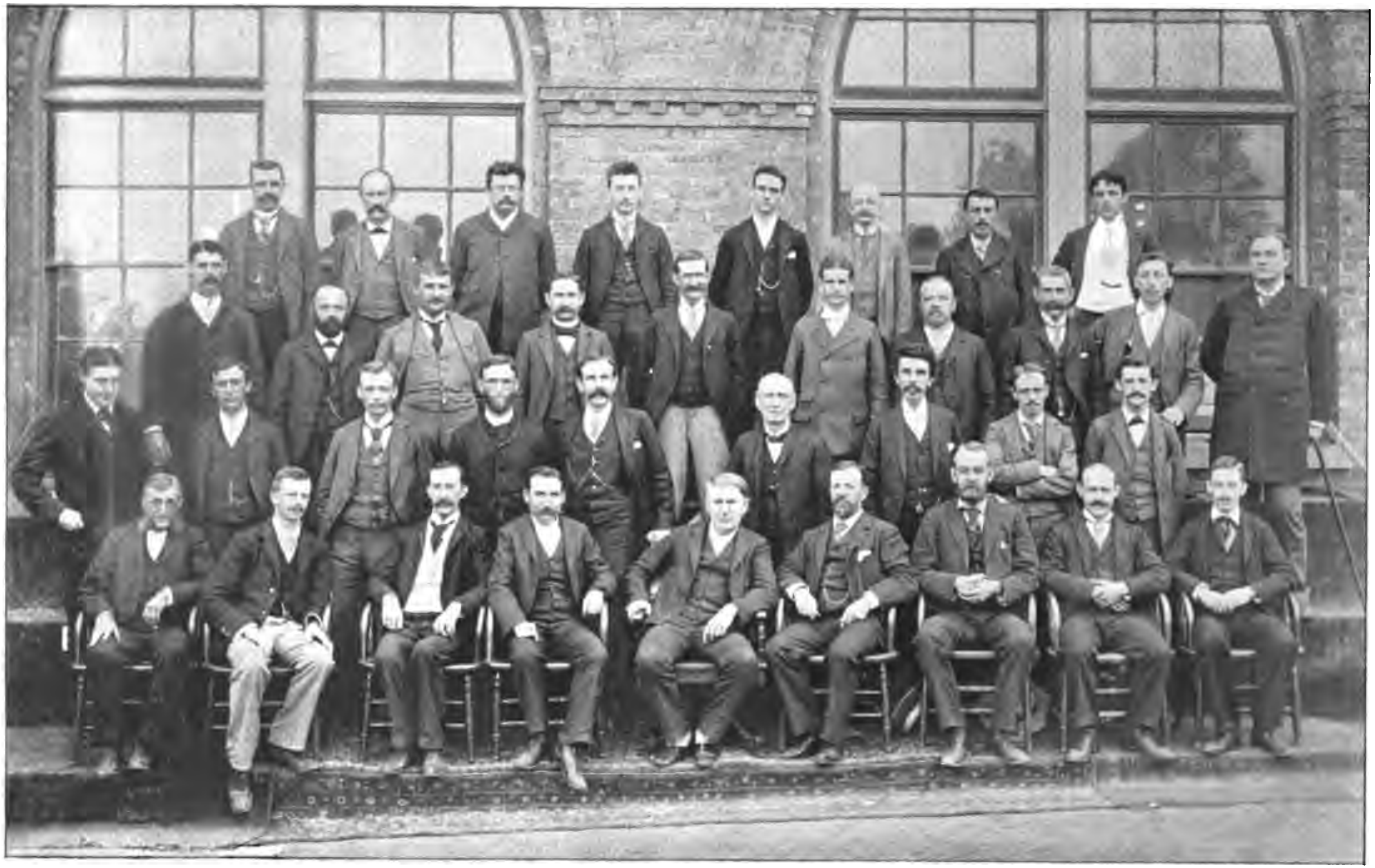
Here are crystals, transparent and translucent, wine-hued, crimson, rose and ocean-green, drenched with sunshine and with moonlit rays; heaps of gems, cut and uncut, dusky garnets, royal amethysts, beryls and topazes; arabesques of copper on

1 —THOS. A. FDISON.
2.—CH. BATCHELOR.
3.—W. S. MALLORY.
4.—J. F. RANDOLPH.
5.—J. W. HARRIS.
6.—J. OTT.
7.—THOS. MAGUIRE.
8.—J. W. GLADSTONE.
9.—CH. BROWN.
10.—A. Y. STEWART.
11.—W. MILLER.
12.—J. W. AYLESWORTH.
13.—J. T. MARSHALL.
14.—A. E. KENNELLY.
15.—P. KENNY.
16.—W. K. L. DICKSON.
17.—T. BANKS.
18.—H. F. MILLER.
19.—A. T. E. WANGEMANN.
20.—H. J. HAGAN.
21.—W. S. LOGUE.
22.—WM. HEISE.
23.—R. LOZIER.
24.—E. W. THOMAS.
25.—F. P. OTT.
26.—F. A. PHELPS, JR.
27.—CH. WURTH.
28.—S. G. BURN.
29.—L. W. SHELDON.
30.—R. ARNOT.
31.—C. H. KAISER.
32.—J. MARTIN.
33.—H. REED,
34.—C. M. DALLY.
35.—F. C. DEVONALD.
36.—A. V. THOMPSON

EDISON AND HIS ORANGE LABORATORY STAFF.

basic slabs, traced by tongues of fire, and ranging from argent to *cramoisi noir;* here a grim meteorite, from Mexico, weighing 1500 pounds; specimens of sulphide and arsenic ores, realgar and oppiment, melting into the loveliest hues of dusky emerald and red; further on a magnificent specimen of stibnite or crystallized sulphide of antimony, worth $100, and weighing thirty pounds, lifting its clustering spires of dull-hued silver.

Here are elfin embroideries of crystallized gold and radiat-



EDISON AND HIS ORANGE LABORATORY STAFF.

ing crystals of antimony, frost-like in their delicate sheen; cubes of gallenite, grouped in a thousand fanciful forms like the architecture of a Niebelung city; pillars of tourmaline—rose and apple-green—fragments of crocidolite, subtly limned like the bronze and gold of a cat's eyes; a great mass of hornblend, white, opaque, and shaped like a sullen tower of the middle ages; portions of sheeny asbestos, bringing with them remembrances of Roman feasts; blocks of velvet malachite, presenting the perfect semblance of emerald plush, and assuming an endless variety of forms, from the grim outlines of a dragon's maw to the cushioned recesses of a faerie throne; blocks of quartz—rose, smoke color and amethyst—petrified rainbows of marcassite and sphalerite, recalling the many-hued Bridge of Asgard; agates in mathematical circles of blue and dove color, lemon and bronze gold! But alack, what intoxication is this that beguiles our senses? We are drunk with luscious color, as with the generous blood of grapes. Not thus may our task be accomplished, not thus may the sober duties of a veracious chronicler be discharged.

The library did not always mirror its present aspect of comfort and beauty. Truth to tell, it was a comparatively gaunt and cheerless abode, depending solely on its literary treasure-troves and scientific models for adornment, but on the occasion of Mr. Edison's forty-second birthday, the place underwent a magical transformation at the hands of the laboratory staff and workmen. Profiting by the convenient absence of their chief, these amiable conspirators proceeded to revolutionize the howling waste. They covered the grim expanse of floor with soft Smyrna rugs, hung the walls with inviting pictures, decorated the middle ground with a tropical display of flower and palm, and scattered a profusion of tables around, solid, capacious and conducive to that squaring of elbows, indispensable to a proper "flow of soul." There are several of these inspirational

pieces of furniture, disposed in the centres of the room and in the recesses at the side, and flanked by eighteen handsomely carved chairs, in oak and leather, embellished with the monogram—T. A. E.

An especially inviting portion of this many-sided hall is the embrasure at the further end, wherein is placed a delightful old-fashioned fireplace, filled with logs, some enchanting easy chairs, and a reading table. The flames are playing merrily over the charred surface of the wood, awakening rosy flushes in the depths and filling the room with cosy crepitations The hum and throb of distant machinery falls drowsily on our ears, the dying rays of the sun slant across the polished mosaic of the floor and the Eastern hues of the carpets. Dynamos and electric motors retreat to the peripheries of our consciousness. We sink into the luxurious depths of an arm-chair, and gazing dreamily into the blackened recesses of the fireplace, are transported to that quaint hostelrie of the Canterbury tales. Here we are:

> "Wel nine and twenty in a compagnie
> Of sondry folk, by aventure yfalle
> In felawship, and pilgrims were they alle,
> That toward Canterbury wolden ride,
> The chambres and the stables weren wide,
> And wel we weren esed atte beste."

In our ears still linger the charmed numbers of that

> "Strain most holy
> The hoary ministrels sang in times of old."

In our drowsy memory stir pleasant recollections of travelers' tales, into our nostrils rises the steam of venison pasty and larded capon, and the fragrance of malvoisie and sack. Alas! for the short-lived visions of the past. Suddenly into our ears, attent to the unfoldings of history's burning scroll, comes a

piercing whistle, another and another, blent into a weird minor discord, which, unfortunately for musical sensibilities, retains its insistent query, and refuses to melt into its legitimate resolution. It is the signal for closing the phonograph works next

PHOTO BY W. K. L. DICKSON

THE DYNAMO ROOM.

door, and with its imperative mandate our poetic fabric tumbles about our ears. No longer are we

"In Southwerk at the Tabard,"

but in a nineteenth century library, replete with the distressing conveniences peculiar to that age. This royal billet, with its gnarled and knotted surface, its scaly bark, encrusted with lichen and powdered with ashes, its ligneous rings and its glowing heart of ruby, is nothing but a cunning counterfeit, wrought of iron and asbestos and lit by multitudinous jets of gas.

PHOTO BY W. K. L. DICKSON

THE LABORATORY STORE-ROOM.

From this palace of enchantment we issue into the store-room, which holds the most unique and comprehensive paraphernalia in the world. Here are specimens of every material which may possibly be needed in connection with Mr. Edison's experiments, and as the inventor's ideas are generally "sparks which flash, red illumed, from the anvil of the brain," brooking no delay in the process of incarnation, and as, moreover, there are no assignable limits to the scope and direction of his erratic genius, the utmost skill and research have been employed in bringing together this material basis for his investigations. Mr. Edison has challenged the skeptical to name one substance, organic or inorganic, which is not to be found in this unique collection. Every department of nature has yielded its tribute to the potent wizard, not merely the superficial products familiar

to every-day use, but those arcana which the ocean and nether world hold in their innermost depths. Space and strength fail us in the enumeration of that endless catalogue. Here

> "A tortoise hung,
> An alligator stuffed, and other skins
> Of ill-shaped fishes,"

the bones of birds and animals, feathers, hides, teeth and horns, many sufficiently gruesome in form to suggest the perambulations of the nocturnal mare. Shining metals, lucent crystals, variegated minerals lie scattered in profusion; dainty shells and coral repose among mosses and sea-weed; fragrant gums and spices recall memories of the fair Babe of Bethlehem. Chalks,

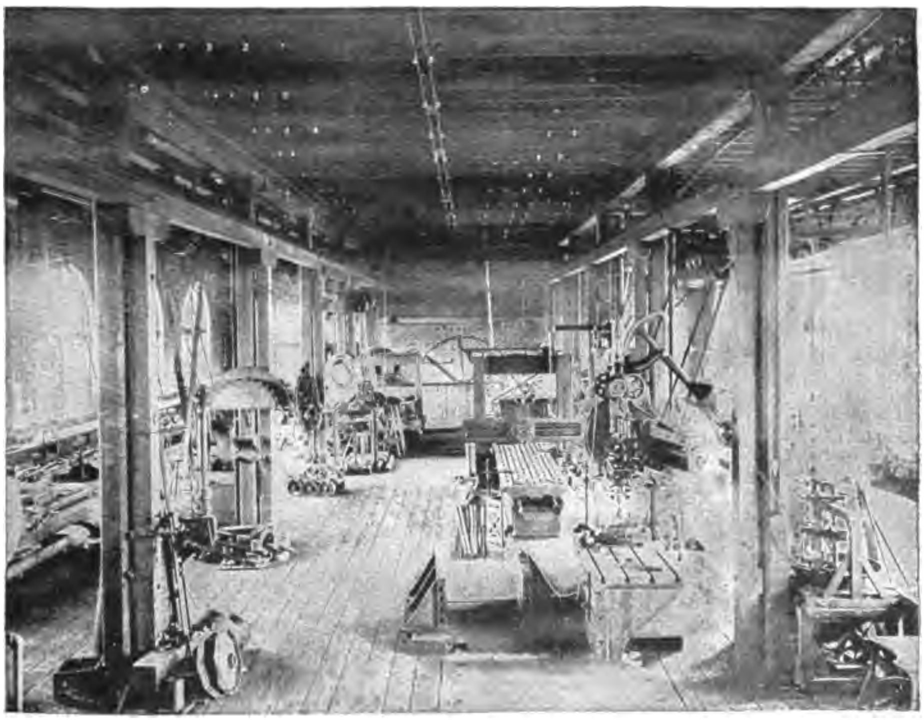


PHOTO BY W. K. L. DICKSON

THE MAIN MACHINE SHOP.

resins, salts and chemicals are heaped about in lavish plenitude, notwithstanding the fact that some of the latter represent a value of $300 an ounce.

The collection embraces not only raw products, but specimens of every imaginable human industry. On the shelves rest piles of textiles, ranging from the coarsest sacking to a gossamer fabric, such as might well have been drawn through the golden ring of the Fairy Prince. These are flanked by metallic sheets of every description, while the floor is occupied by a motley mass of ropes, twines, bundles of brass and iron tubing, paper, oil-cloth, gutta-percha, leather, slabs of granite, marble, slate, etc., etc. A general and totally unclassifiable litter of trade devices is lying loosely around. A sanguinary meat chopper impedes our path in one direction and an ice cream freezer in another, offers its softer suggestions of summer nights and luscious syrups, while pickaxes, saws, coffee-mills, wheelbarrows, ladders and what not bewilder our limited visual scope. Specimens of human manufacture, not only the limited appliances of the past, but the perfected outcome of the present, are fully represented, but in a profusion which forbids anything but the most superficial survey. It has been well said, in summing up the whole heterogeneous supply, that it comprises all the requisites of "a dry goods, grocery, drug, ironmongery, glass, chandlery, oil, paper, rubber, leather, grain, hardware, stationary, chemical and feather store all in one, and that there is not any article known to civilized man, from a bootjack to a locomotive, the materials entering into the manufacture of which could not be furnished from this storeroom."

From the storeroom we pass into the lower machine shop, devoted to the construction of the heavier mechanism used in dynamos, ore-milling machines, etc., and are met by a bewildering din and clanking and throbbing as the great metallic giants sullenly perform their varied functions in the service of man.

It is with feelings of overpowering wonder, not unmixed with awe, that we take cognizance of these embodiments of nineteenth century energy, these swiftly rotating wheels, this pulsating machinery, these mysterious motions of drilling, cutting, pressing and boring, outcomes of an invisible and irresistible force. Truly, as Holmes hath it,

> "After all, it is the imponderable that moves the world, heat, electricity, love."

On one side we are confronted by massive mining drills, on another we are met with an array of electric motors, used for the purpose of transmuting the subtle forces of electricity into the grosser forms of mechanical energy. A switchboard, or apparatus for the interchange of circuits, controls these motors, and is placed in the centre of the shop, so that the power may be directed to any given point. The presiding genii of this section are grim to behold, caked in smut and dirt, and powdered with shining filaments of iron and steel, but they are beneficent genii for all that, and favor us as we pass with a display of ivories, rendered peculiarly effective by its swarthy encasement. In the dynamo room are displayed various types of the electrical generators, sources of the current employed in the illumination of Mr. Edison's laboratory and house. The motive power for the laboratory machinery is furnished by a Brown engine of sixty horse-power, and the dynamos are impelled by Armington and Sims engines. Babcock and Wilcox boilers are employed, aggregating two hundred and twenty five horse-power. A feature of this establishment is the prevalence of magnetism, which is so potent that we are advised to remove our watches before entering the charmed precincts.

An elevator brings us to the second floor, from which we step into the "Precision department," embracing the lighter

PHOTO BY W. K. L. DICKSON

THE PATTERN AND CARPENTER SHOP.

and more delicate machines, such as the phonograph and its vibrating diaphragm, with its fairy-like sapphire needle, the kinetoscope, kinetograph and other apparatus. As may be imagined, the skill employed in this department is of a

superior grade and commands a very much higher rate of remuneration.

Very attractive is the glass-blowing room, located on the same floor, and devoted to the construction of the experimental lamps. We spend a few moments watching the deft manipulation of the operator as he wields the plastic crystal, molding the fairy spheres and sending out clusters of shining threads. Adjoining this department is the mercury vacuum pump room, where the delicate globes are exhausted of air after the insertion of the carbon filaments. On this floor may also be found the series of rooms devoted to the development of ideas suggested in rude sketches, prepared by the inventor, and elaborated by the leading members of the staff. Interwoven with the maturing of these suggestive thoughts is the process of "bug hunting," which is carried out with an ardor which allows no disorderly element to escape. Perhaps it may be as well to explain here, for the benefit of those unacquainted with laboratory terms, that "bug hunting" does not necessarily mean an entomological expedition, but the discovery and elimination of defects in connection with inventions in process of completion.

An interesting sight is afforded by the lamp test room, located on the top floor, and devoted to the accommodation of lamps in process of surveillance, the object being to determine the efficiency and lasting power of each light, with a view to eliminating every conceivable defect before it is placed in the market. To this end a ceaseless watch is maintained, and a minute biographical record compiled, relative to each individual lamp, the whole constituting what is known as a "life test." Nothing more brilliant and beautiful can be imagined than this aggregation of shining bulbs, suggesting stellar and planetary combinations foreign to our astronomical experience. We seem in presence of

> "Larger constellations burning, mellow moons and happy skies."

But we should be in evil case, were our heavenly system subject to the disturbances which invade these sublunary spheres. Even as we stand, gazing admiringly at the golden radiance, a shiver runs through the clustered lights, a delicate crepitation, a silvery clang, and we are powdered with shining fragments, a catastrophe which brings to mind, in a mimic way, the pleasing wind-up of terrestrial affairs portrayed in Monsieur Flammarion's latest cosmic nightmare.

CHAPTER XXII.

ORANGE LABORATORY, CONTINUED.—THE EXHIBITION HALL. LECTURE HALL. THE OUTBUILDINGS. THE CHEMICAL ROOM. MAIN PHOTOGRAPHIC BUILDING. THE KINETOS. THE KINETOGRAPHIC THEATRE.

THE KINETOGRAPHIC THEATRE AT ORANGE.

A PORTION of the establishment most worthy of the attention of students was the hall devoted to the exhibition of the inventor's creations. Prior to the exodus and disruption of 1889, these were arranged in complete order and in chronological sequence, but the Paris Exhibition occasioned the removal of many of these machines, and the collection has never regained its pristine completeness. Many of the inventions are still slumbering in the inglorious seclusion of their respective sarcophagi, and those which have escaped entombment have been sacrificed to Mr. Edison's careless disregard for fame. Whenever it seems good to this Tantalus of Science, his scientific progeny are coolly dismembered to form new feasts of reason, a fate which has befallen so many of the machines that the show-cases, once devoted to their symmetrical entirety, now enclose nothing but mangled remains. Of course, as is the case of Pelops and Aeson, the elements of resuscitation are within, and may be built up on the original plan, but in the meantime the disintegration is somewhat painful to contemplate.

On our way to the lower regions, we pass the lecture hall, formerly in use for musical experiments in connection with the

PHOTO BY W. K. L. DICKSON

THE CHEMICAL ROOM.

phonograph. If the nymph Echo and her coy attendants could be placed *en évidence* what tales could they not tell of the harmonies to which they have lent an antiphonal chorus?

The outbuildings now engage our attention. The chemical room is a favorite of Edison, and here he often may be found, draped in an unsightly toga, the groundwork of which may once have been brown, but which is now embellished with strange devices in magenta, arsenic-green and yellow, the result of divers chemical catastrophes. He seems to be inhaling the evil smells with a gusto, undiminished since the days when he blew up his establishment on the Port Huron cars. Let us hope that the charmed life which he has borne in the past will extend far into the future, and that Orange may not be afforded the thrilling spectacle of a disintegrated inventor, taking an involuntary flight over his own chimneys.

The buildings devoted to photographic work, including the kinetoscopic experiments, are among the first things that meet the visitor's eye on approaching the grounds. The main photographic building is divided into the following compartments: In the general work room, which is covered with sliding glass skylight and side windows, a number of cameras of different sizes, equipped with fine lenses, are idly waiting their turn to be focused on some new object. Science and nature are so happily united that no diurnal variations are permitted to impede the development of a subject, and unfinished work is completed at night by the aid of a large group of arc lamps, giving out fifteen thousand candle-power, supplemented by several calcium light appliances. At one side of the room may be seen one of the celebrated Zeiss micro-photographic outfits, which has been of inestimable service during the many Edison lamp suits, in magnifying, to an extraordinary degree, the sectional views of the fibro-vascular bundles used in the manufacture of the carbon filament. Many micro-photographs have also been made by the aid of this valuable apparatus in connection with Mr. Edison's bacterial researches. The processes of silvering, printing, mounting, retouching and burnishing are carried on in this department, and the work bench and lathe, which occupy one corner, are in constant demand for kinetoscopic and kinetographic experiments.

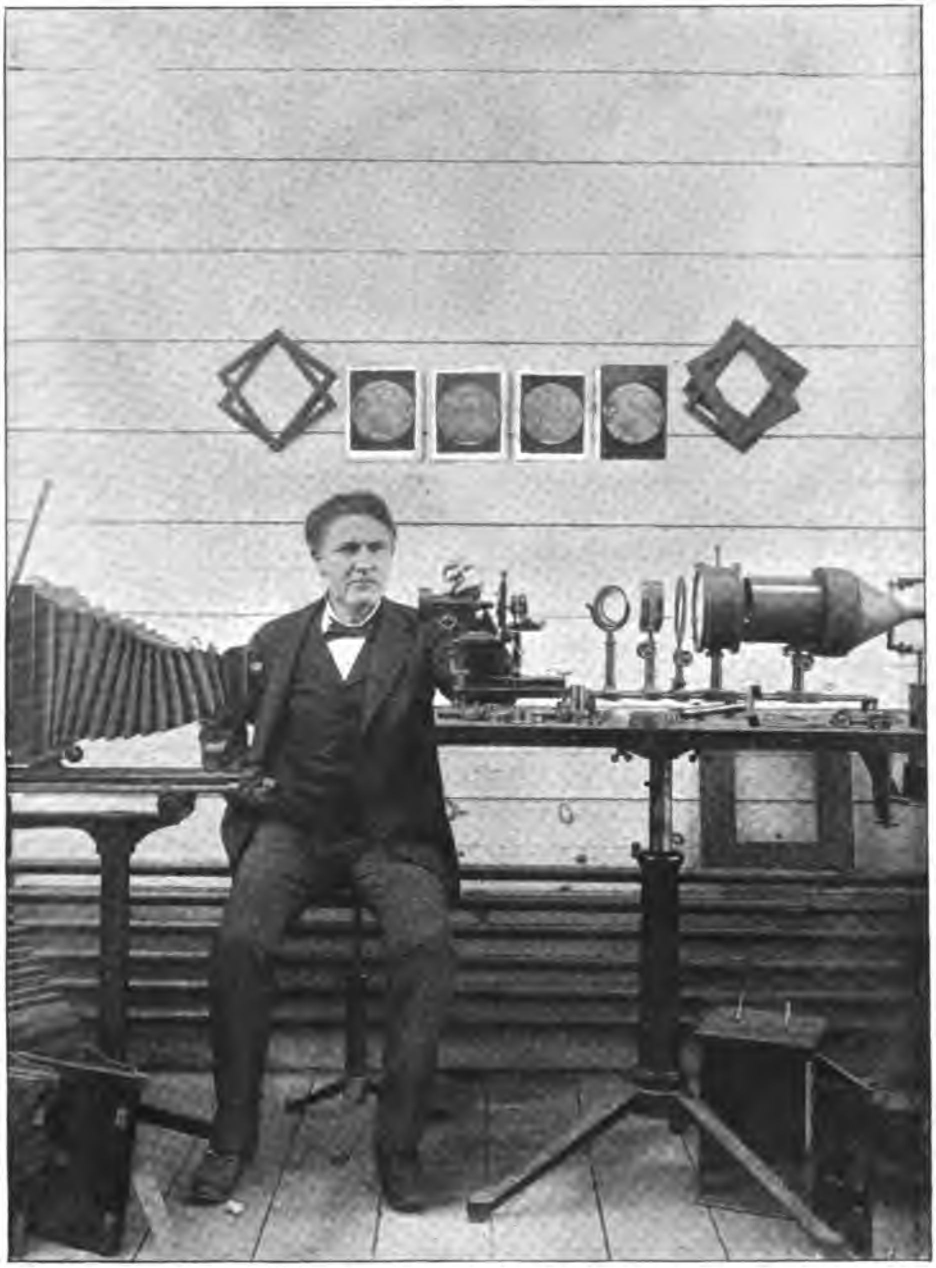
The rooms above are devoted to copying and enlarging, as well as to the experiments in lantern projection. Around this room are stacked over a thousand negatives, to which additions are constantly made, and many of which are used to illustrate this work. The dark rooms are arranged in consecutive order, are well ventilated, heated by steam in the winter and lighted by incandescent lamps, enclosed in ruby glass compartments and softened at will by lowering the candle-power. These dark rooms greatly resemble huge ice boxes as to construction, the walls being filled in with sawdust to keep the temperature cool

in summer. It is here that the kinetoscopic films are treated, and during their many manipulations the operators are at times forced to work in Egyptian darkness, owing to the extreme sensitiveness of the film, which necessitates total exclusion of light, even to the extinction of the ruby glow.

A cursory reference has already been made to the kinetoscope and kineto-phonograph, which were born amid these mysterious surroundings, and it may be well, before seeking new fields of thought, to trace the evolution and present status of these latest marvels of the laboratory. The initial ideas, relating to the reproduction of motion, are based upon the familiar toy known as the zoetrope or wheel of life. This rude prototype contains a cylinder ten inches in width and open at the top, around the lower half of whose interior a series of pictures is placed, representing any sequence of motion it may be desired to portray, such for instance as wrestling, jumping, or the swift progress of animals. These movements are seen through the narrow vertical slits in the cylinder during the rapid revolution of the little machine, and are designed to blend into one continuous impression. In the zoetrope, however, the pictures are wood cuts of rude execution, and the limited speed attainable in the production of these militate against the life-like effect, producing a series of jerks instead of the desired continuity of motion. When instantaneous photography, as evolved by Maddox and others, was utilized, superior results were attained, but it seemed impossible to take pictures at sufficiently short intervals to secure the absolute blending of outline essential to a faithful portrayal of life. Matters were in this unsatisfactory condition when the resources of the laboratory were brought to bear upon the problem.

And now let us hear Mr. Edison himself on the subject:

"In the year 1887 the idea occurred to me that it was possible to devise an instrument which should do for the eye



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EDISON EXPERIMENTING WITH MICROGRAPHY.

what the phonograph does for the ear, and that by a combination of the two, all motion and sound could be recorded and reproduced simultaneously. This idea, the germ of which came from the little toy called the zoetrope, and the work of Muybridge, Marie and others, has now been accomplished, so that every change of facial expression can be recorded and reproduced life size. The kinetoscope is only a small model, illustrating the present stage of progress, but with each succeeding month new possibilities are brought into view.

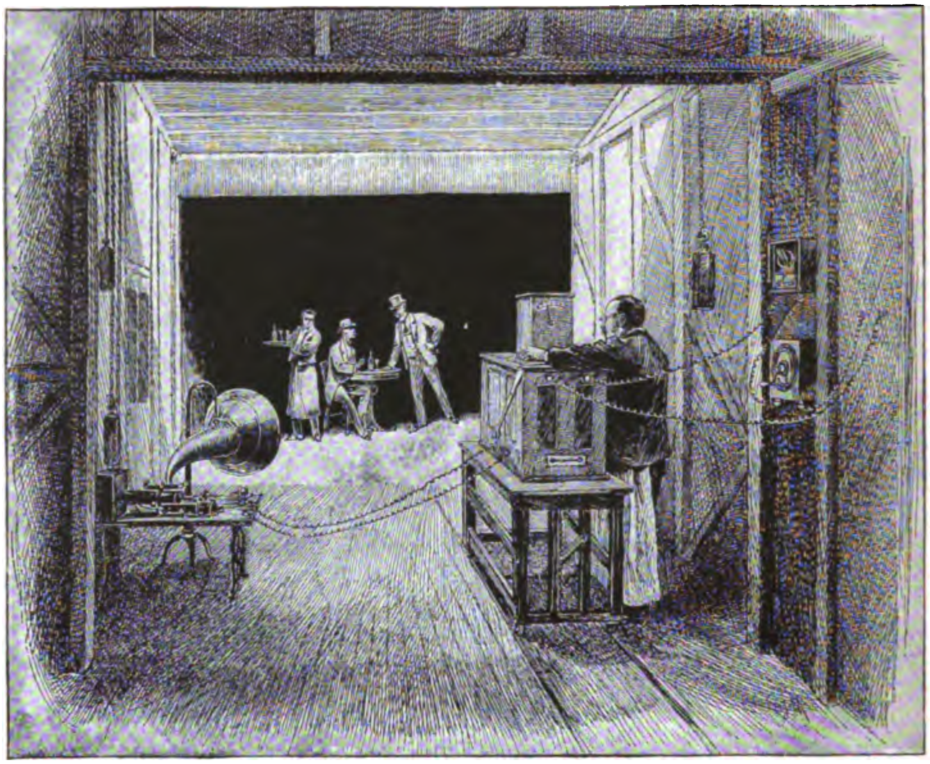
"I believe that in coming years, by my own work and that of Dickson, Muybridge, Marie and others who will doubtless enter the field, grand opera can be given at the Metropolitan Opera House at New York without any material change from the original, and with artists and musicians long since dead."

The synchronous attachment of photography with the phonograph was early contemplated by Mr. Edison, in order to record and give back impressions to the eye as well as to the ear.

The comprehensive term for this invention is the kinetophonograph; the dual "taking-machine" is the phono-kinetograph, and the reproducing-machine the phono-kinetoscope, in contradistinction to the kinetograph and the kinetoscope, which relate respectively to the taking and reproduction of movable but *soundless* objects.

The initial experiments took the form of microscopic pin-point photographs, placed on a cylindrical shell, corresponding in size to the ordinary phonograph cylinder. These two cylinders were then placed side by side on a shaft, and the sound record was taken as near as possible synchronously with the photographic image impressed on the sensitive surface of the shell. The photographic portion of the undertaking was seriously hampered by the defects of the materials at hand, which, however excellent in themselves, offered no substance sufficiently sensitive. How

to secure clear-cut outlines, or indeed any outlines at all, together with phenomenal speed, was the problem which puzzled the experimenters. The Daguerre, albumen, and kindred processes met the first requirements, but failed when subjected



DRAWN BY E. J. MEEKER

INTERIOR OF THE KINETOGRAPHIC THEATRE.

to the test of speed. These methods were therefore regretfully abandoned, a certain precipitate of knowledge being retained, and a bold leap was made to the Maddox gelatine bromide of silver emulsion, with which the cylinders were coated. This process gave rise to a new and serious difficulty. The bromide of silver haloids, held in suspension with the emulsion, showed themselves in an exaggerated coarseness when it became a ques-

tion of enlarging the pin-point photographs to the dignity of one-eighth of an inch, projecting them upon a screen, or viewing them through a binocular microscope. Each accession of size augmented the difficulty, and it was resolved to abandon that line of experiment, and to revolutionize the whole nature of the proceedings by discarding these small photographs, and substituting a series of very much larger impressions, affixed to the outer edge of a swiftly rotating wheel or disk, and supplied with a number of pins, so arranged as to project under the centre of each picture. On the rear of the disk, upon a stand, was placed a Geissler tube, connected with an induction coil, the primary wire of which, operated by the pins, produced a rupture of the primary current, which, in its turn, through the medium of the secondary current, lighted up the Geissler tube at the precise moment when a picture crossed its range of view.

This electrical discharge was performed in an inappreciable fraction of time; the succession of pictures was so rapid, and the whole mechanism so nearly perfect, that the goal of the inventor seemed almost reached.

Then followed some experiments with drums, over which sheets of sensitized celluloid film were drawn, the edges being pressed into a narrow slot in the surface, similar in construction to the old tin-foil phonograph. A starting-and-stopping device very similar to the one now in use was also applied. The pictures were then taken spirally to the number of two hundred or so, but were limited in size, owing to the rotundity of surface, which brought only the centre of the picture into focus. The sheet of celluloid was then developed, fixed, and otherwise prepared, and placed on a transparent drum, bristling at its outer edge with brass pins. When the drum was rapidly turned, these came in contact with the primary current of an induction coil, and each image was lighted up in the same manner as

THE RECORD OF A SNEEZE.

THE RECORD OF A SNEEZE.

described in the previous disk experiment, with this difference only, that the inside of the drum was illuminated.

The next step was the adoption of a highly sensitized strip of celluloid half an inch wide; but this proving unsatisfactory, owing to inadequate size, one-inch pictures were substituted on a band one and a half inches wide, the additional width being required for the perforations on the outer edge. These perforations occur at close and regular intervals, in order to enable the teeth of a locking device to hold the film steady for nine-tenths of the one forty-sixth part of a second, when a shutter opens rapidly and admits a beam of light, causing an image or phase in the movement of the subject. The film is then jerked forward in the remaining one-tenth of the one forty-sixth part of a second, and held at rest while the shutter has again made its round, admitting another circle of light, and so on until forty-six impressions are taken a second, or 2760 a minute. This speed yields 165,600 pictures in an hour, an amount amply sufficient for an evening's entertainment, when unreeled before the eye. By connecting the two ends of the strip, and thus forming a continuous band, the pictures can be indefinitely multiplied. In this connection it is interesting to note that were the spasmodic motions added up by themselves, exclusive of arrests, on the same principle that a train record is computed independent of stoppages, the incredible speed of twenty-six miles an hour would be shown.

The advantage of this system over a continuous band, and of a slotted shutter forging widely ahead of the film, would be this, that in that case only the fractional degree of light comprised in the $\frac{1}{2720}$ part of a second is allowed to penetrate to the film at a complete sacrifice of all details, whereas in the present system of stopping and starting, each picture gets one-hundreth part of a second's exposure, with a lens but slightly stopped down, time amply sufficient, as any photographer knows, for the

attainment of excellent detail even in an ordinarily good light. It must be understood that only one camera is used for taking these strips, and not a battery of cameras, as in Mr. Muybridge's photographs of "the horse in motion."

The next step after making the negative band, is to form a positive or finished series of reproductions from the negative, which is passed through a machine for the purpose, in conjunction with a blank strip of film, which, after development and general treatment, is replaced in the kinetoscope or phonokinetoscope, as the case may be. When a phonograph record has been taken simultaneously with such a strip, the two are started together by the use of a simple but effective device, and kept so all through, the phonographic record being in perfect accord with the strip. In this conjunction, the tiny holes with which the edge of the celluloid film is perforated correspond exactly with the phonographic record, and the several devices of the camera, such as the shifting of the film and the operations of the shutter, are so regulated as to keep pace with the indentation made by the stylus upon the phonographic wax cylinder, one motor serving as a source of common energy to camera and phonograph when they are electrically and mechanically linked together.

The establishment of harmonious relations between kinetoscope and phonograph was a harrowing task, and would have broken the spirit of inventors less inured to hardship and discouragement than Edison's veterans. The experiments have borne their legitimate fruit, and the most scrupulous nicety of adjustment has been achieved, with the resultant effects of realistic life, audibly and visually expressed.

The process of "taking" is variously performed—by artificial light in the photographic department, or by daylight under the improved conditions of the new theatre, of which we shall speak. The actors, when more than one in number, are

CARMENCITA.

kept as close together as possible, and exposed either to the glare of the sun, to the blinding light of four parabolic magnesium lamps, or to the light of twenty arc lamps, provided with highly actinic carbons, supplied with powerful reflectors equal to about fifty thousand candle-power. This radiance is concentrated upon the performers while the kinetograph and phonograph are hard at work storing up records and impressions for future reproductions.

A popular and inexpensive adaptation of kinetoscopic methods is in the form of the well-known nickel-in-the-slot, a machine consisting of a cabinet containing an electrical motor and batteries for operating the mechanism which acts as the impelling power to the film. The film is in the shape of an endless band from fifty to one hundred and fifty feet in length, which is passed through the field of a magnifying glass perpendicularly placed. The photographic impressions pass before the eye at the rate of forty-six per second, through the medium of a rotating, slotted disk, the slot exposing a picture at each revolution, and separating the fractional gradations of pose. Projected against a screen, or viewed through a magnifying glass, the pictures are eminently life-like, for the reason that the enlargement need not be more than ten times the original size. On exhibition evenings the projecting-room, which is situated in the upper story of the photographic department, is hung with black, in order to prevent any reflection from the circle of light emanating from the screen at the other end, the projector being placed behind a curtain, also of black, and provided with a single peep-hole for the accommodation of the lens. The effect of these sombre draperies, and the weird accompanying monotone of the electric motor attached to the projector, are horribly impressive, and one's sense of the supernatural is heightened when a figure suddenly springs into his path, acting and talking with a vigor which leaves him totally unpre-

pared for its mysterious vanishing. Projected stereoscopically, the results are even more realistic, as those acquainted with that class of phenomena may imagine, and a pleasing rotundity is apparent, which, in ordinary photographic displays, is conspicuous by its absence.

Nothing more vivid or more natural could be imagined than these breathing, audible forms with their tricks of familiar gesture and speech. The inconceivable swiftness of the photographic successions, and the exquisite synchronism of the phonographic attachment, have removed the last trace of automatic action, and the illusion is complete. The organ grinder's monkey jumps upon his shoulder to the accompaniment of a strain from "Norma." The rich tones of a tenor or soprano are heard, set in their appropriate dramatic action; the blacksmith is seen swinging his ponderous hammer, exactly as in life, and the clang of the anvil keeps pace with his symmetrical movements; along with the rhythmical measures of the dancer go her soft-sounding foot falls; the wrestlers and fencers ply their intricate game, guarding, parrying, attacking, thrusting and throwing, while the quick flash of the eye, the tension of the mouth, the dilated nostrils, and the strong, deep breathing give evidence of the potentialities within.

The photographic rooms, with their singular completeness of appointment, have been the birthplace and nursery of this invention; and the more important processes connected with the preparation and development of the film, together with their mechanical and scientific devices, are still carried on in this department. The exigencies of natural lighting incident to the better "taking" of the subjects, and the lack of a suitable theatrical stage, however, necessitated the construction of a special building, which stands in the centre of that cluster of auxiliary houses which forms the suburbs of the laboratory, and which is of so peculiar an appearance as to challenge the

attention of the most superficial observer. It obeys no architectural rules, embraces no conventional materials and follows no accepted scheme of color. Its shape is an irregular oblong, rising abruptly in the centre, at which point a movable roof is attached, which is easily raised or lowered at the will of a single manipulator. Its color is a grim and forbidding black, enlivened by the dull lustre of many hundred metallic points; its material is paper, covered with pitch and profusely studded with tin nails. With its flapping sail-like roof and ebon hue, it has a weird and semi-nautical appearance, and the uncanny effect is not lessened when, on an imperceptible signal, the great building swings slowly around upon a graphited centre, presenting any given angle to the rays of the sun, and rendering the operators independent of diurnal variations. The movable principle of this building is identical with that of our river swinging bridges, the ends being suspended by iron rods from raised centre-posts. This building is known as the

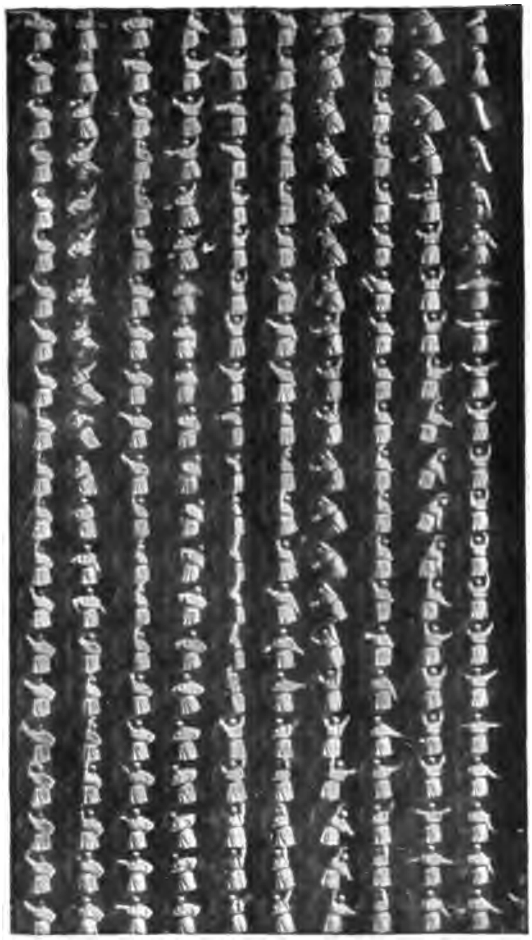


PHOTO BY W. K. L. DICKSON

AN EARLY KINETOGRAPHIC EXPERIMENT.

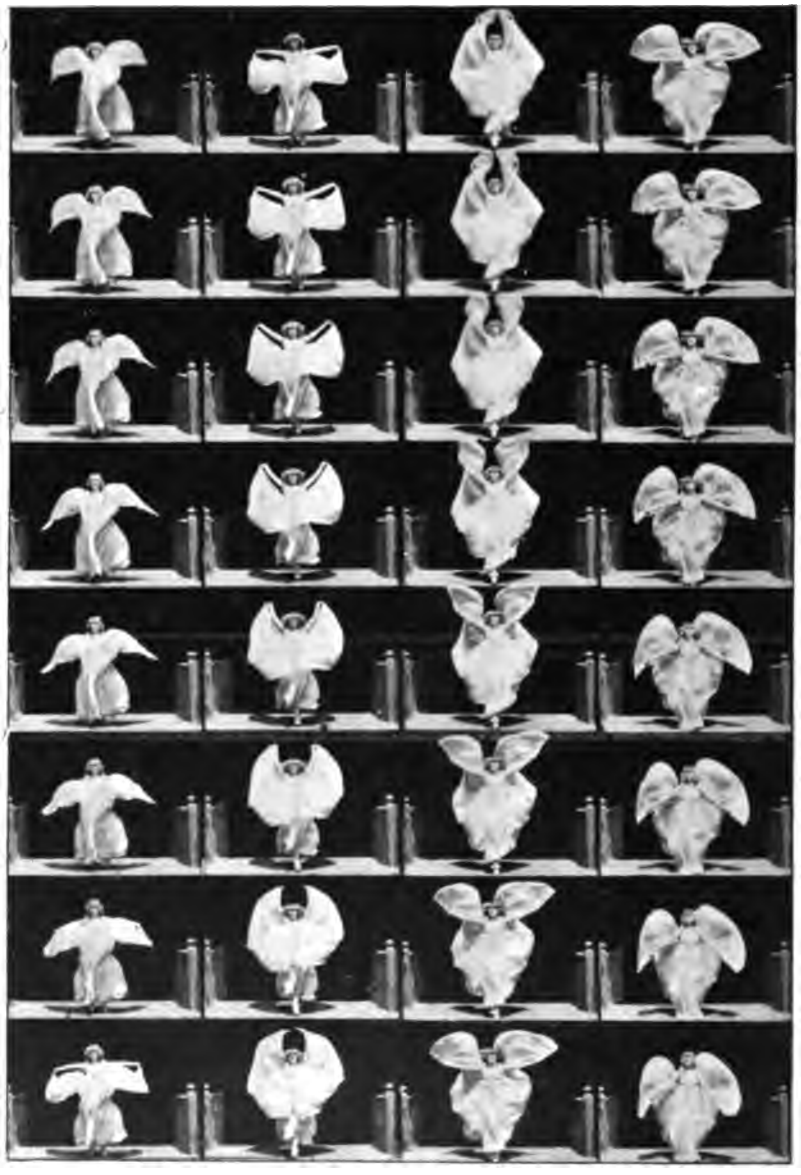


PHOTO BY W. K. L. DICKSON

A SERPENTINE DANCE.

Kinetographic Theatre, otherwise the "Black Maria." Entering, we are confronted by a system of lights and shades so sharply differentiated as to pain the eye, accustomed to the uniform radiance of the outer air.

As we peer into the illusive depths we seem transported to one of those cheerful banqueting halls of old, where the feudal chief made merry with human terrors, draping the walls with portentous black, and thoughtfully providing a set of coffins for the accommodation of his guests. And what is this mysterious recess at the other extremity, sharply outlined against the dazzling radiance of the middle ground and steeped in an angry crimson hue? Are these inquisitorial dungeons, and is that lurid glare the advance guard of the awful Question? Is that gentle persuasive in process of administration, and do these half-guessed recesses conceal the hellish paraphernalia of rack and screw, glowing iron and crushing stone? Has the doom of ages overtaken our wizard at last, and is he expiating, with twisted limb and scorching flesh, the treasures of his unlawful wisdom? Ah! me, that the prosaic truth must be told! No dungeons are these, thrilling with awful possibilities, but simply a building for the better "taking" of kinetoscopic subjects. On the platform stand the wrestlers, pantomimists, dancers and jugglers, whose motions it is destined to immortalize. Against the nether gloom their figures stand out with the sharp contrast of alabaster basso-relievos on an ebony ground, furnishing a satisfactory explanation for the singular distinctness of the kinetoscopic strips. The lurid cell, at the other end, resolves itself into a compartment for changing the films from the dark box to the kinetoscopic camera, the apparatus being run backward over a track leading from the black tunnel at the rear of the stage to this room, after which the door is shut and the films renewed for a fresh subject.

We have been sensible for some time of a disturbance in the ground beneath our feet, and are now aware that the build-

ing is slowly and noiselessly rotating on an axis, bringing into our range of vision the glory of the sun-rays westering to their close. Again we are reminded of that indissoluble chain of ideas which links the past with the present, and into the commonplace of existing facts come memories of that chamber in the golden house of Nero, so arranged that "by means of skillfully planned machinery it moved on its axis, thus following the motion of the heavens, so that the sun did not appear to change in position, but only to descend and ascend perpendicularly."

The *dramatis personæ* of the kinetographic stage are recruited from every characteristic section of social, artistic and industrial life, and from many a phase of animal existence. One day chronicled the engagement of a troupe of trained bears and their Hungarian leaders. The bears were divided between surly discontent and a comfortable desire to follow the bent of their own inclinations. It was only after much persuasion that they could be induced to subserve the interests of science. One furry monster waddled up a telegraph pole, to the soliloquy of his own indignant growls; another settled himself comfortably in a deep arm-chair, with the air of a post-graduate in social science; a third rose solemnly on his hind legs and described the measures of some unclassified dance, to the weird strains of his keeper's music. Another licked his master's swarthy face, in deprecation of the invitation to move, while another accepted his keeper's challenge, and engaged with him in a wrestling match, struggling, hugging and rolling on the ground.

Of human subjects we have a superfluity, although the utmost discrimination is essential in the selection of themes. The records embrace pugilistic encounters, trapeze and cane exercises, dancing, wrestling, fencing, singing, the playing of instruments, speech-making, the motions involved in the different crafts, horse-shoeing, equestrianism, gardening and many others.

We have yet to speak of the microscopic subjects, a class

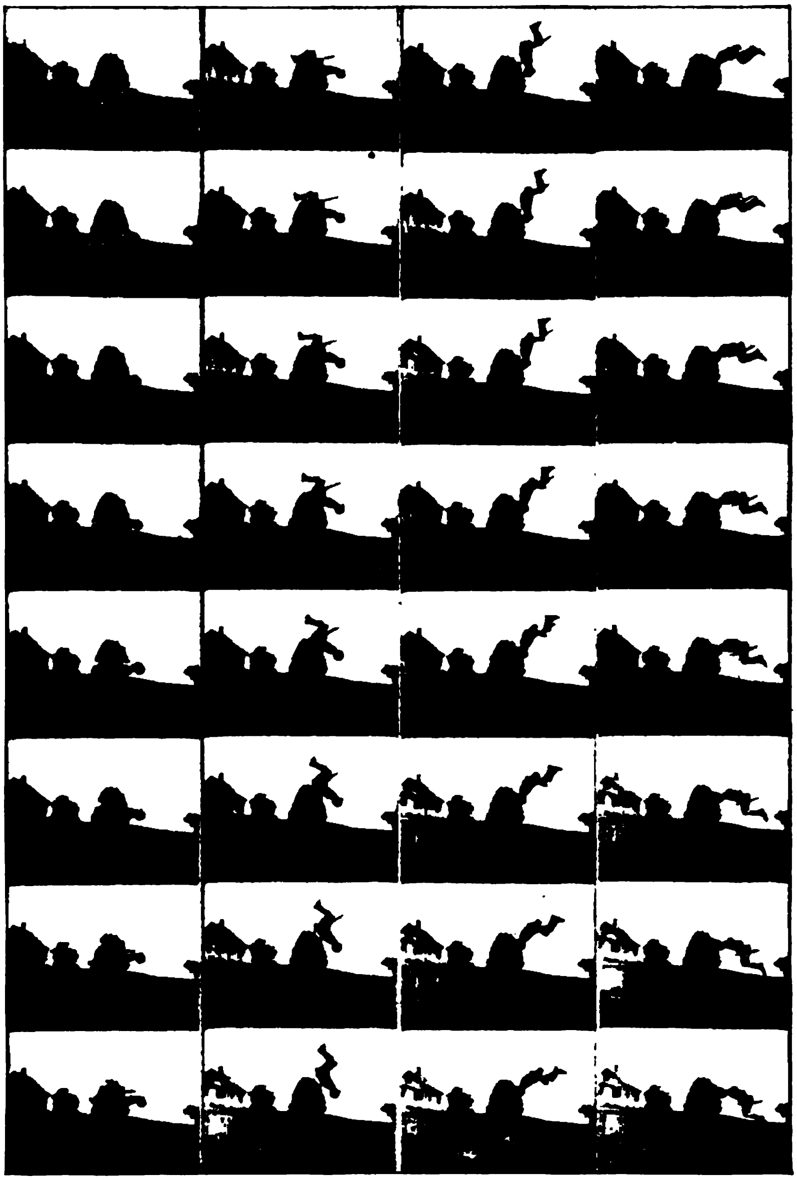


PHOTO BY W. K. L. DICKSON

CAICEDO, THE KING OF ROPE DANCERS.

of especial interest, as lying outside of the unaided vision of man. In the treatment of these infinitesimal types, much difficulty was experienced in obtaining a perfect adjustment so as to reproduce the breathing of insects, the circulation of blood in a frog's leg and other attenuated processes of nature. The enlargement of animalculæ in a drop of stagnant water proved a most exacting task, but by the aid of a powerful lime-light, concentrated on the water, by the interposition of alum cells for the interception of most of the heat-rays, and by the use of a quick shutter and kindred contrivances, the obstacles were overcome, and the final results were such as fully to compensate for the expenditure of time and trouble.

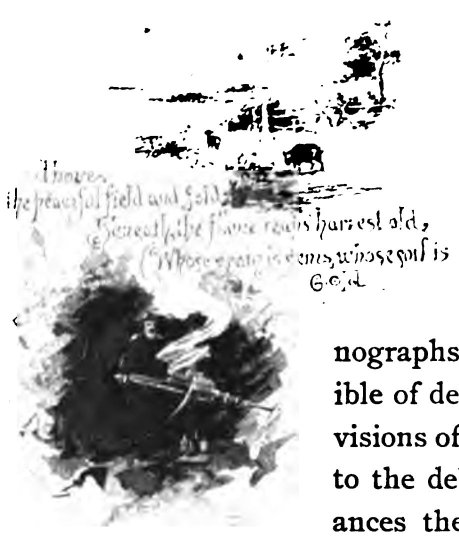
We will suppose that the operator has at last been successful in imprisoning the tricksy water-goblins on the sensitive film, in developing the positive strip, and placing it in the projector. A series of inch-large shapes then springs into view, magnified stereoptically to nearly three feet each, gruesome beyond power of expression, and exhibiting an indescribable celerity and rage. Monsters close upon one another in a blind and indiscriminate attack, limbs are dismembered, gory globules are tapped, whole battalions disappear from view. Before the ruthless completeness of these martial tactics the Kilkenny cats fade into insignificance. A curious feature of the performance is the passing of these creatures in and out of focus, appearing sometimes as huge and distorted shadows, then springing into the reality of their own size and proportions.

Hitherto we have limited ourselves to the delineation of detached subjects, but we shall now touch very briefly upon one of our most ambitious schemes, of which these scattered impersonations are but the heralds. Preparations have long been on foot to extend the number of the actors and to increase the stage facilities, with a view to the presentation of an entire play, set in its appropriate frame.

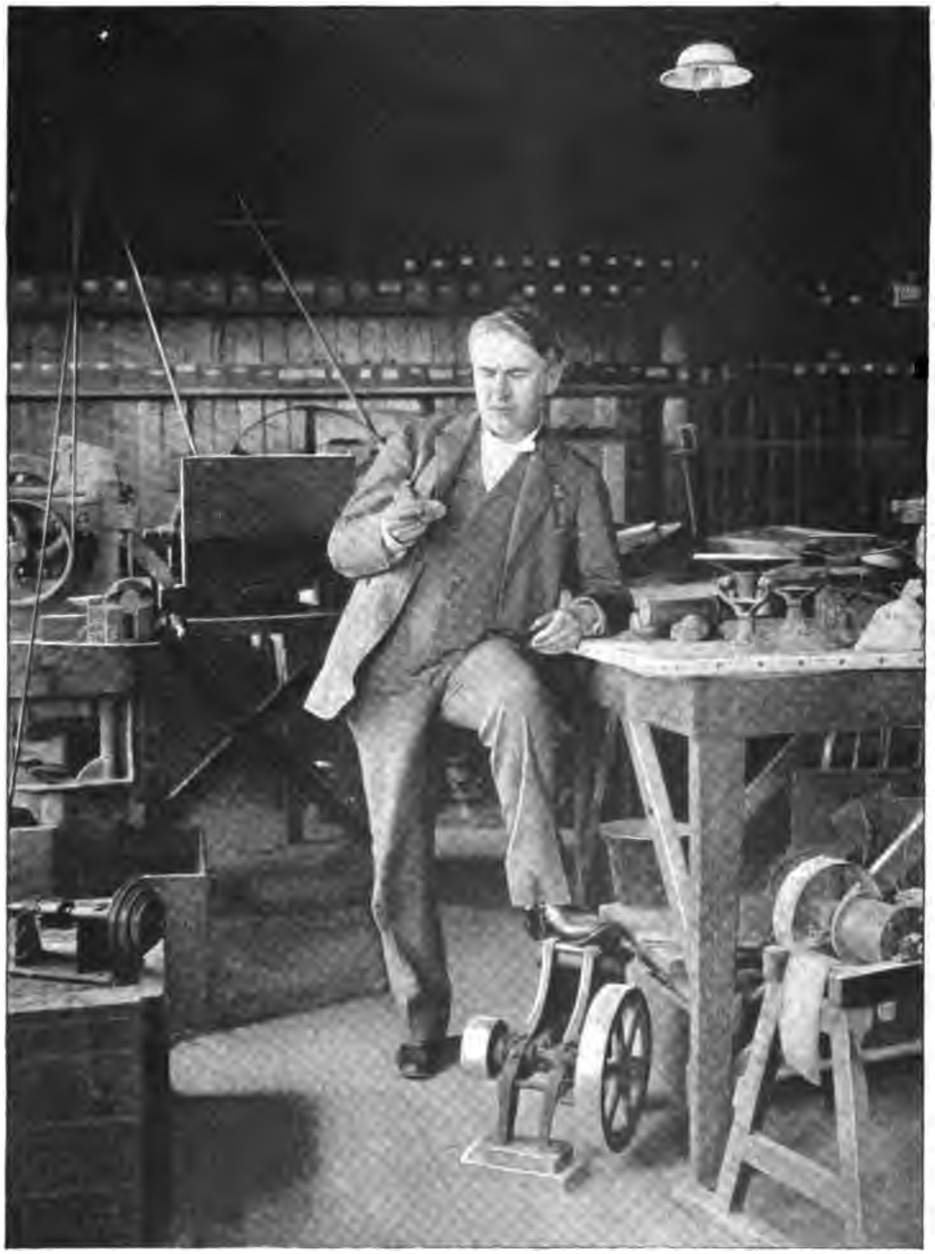
This line of thought may be indefinitely pursued, with application to any given phase of outdoor or indoor life which it is desired to reproduce. Our methods point to ultimate success, and every day adds to the security and the celerity of the undertaking. No scene, however animated and extensive, but will eventually be within reproductive power. Martial evolutions, naval exercises, processions and countless kindred exhibitions will be recorded for the leisurely gratification of those who are debarred from attendance, or who desire to recall them. The invalid, the isolated country recluse, and the harassed business man can indulge in needed recreation, without undue expenditure, without fear of weather, and without the sacrifice of health or important engagements. Not only our own resources but those of the entire world will be at our command. The advantages to students and historians will be immeasurable. Instead of dry and misleading accounts, tinged with the exaggerations of the chroniclers' minds, our archives will be enriched by the vitalized pictures of great national scenes, instinct with all the glowing personalities which characterized them.

CHAPTER XXIII.

GALVANOMETER DEPARTMENT. ORE MILLING. MAGNETIC ORE SEPARATORS. ELECTROCUTION. THE FORT MEYERS LABORATORY AND HOUSE.



THE galvanometer department is among the most interesting in Edison's laboratory, and contains a vast collection of valuable electrical instruments, galvanometers, magnetometers, cathetometers, electrometers, photometers, chronographs, Wheatstone bridges, etc., susceptible of determining the most minute subdivisions of electricity or time. In deference to the delicate sensibilities of these appliances the fixtures of the room are constructed of brass and other non-magnetic substances. Much difficulty was experienced in the construction of this room, and in order to secure absolute stability, it was found necessary to build brick foundations to a depth of twenty feet and place stone tables on these for the reception of the instruments. This department was until lately under the charge of Mr. Kennelly, the quick flash of whose humor and the delicate poise of whose faculties seem a reflex of the instruments entrusted to his care. Those sufficiently fortunate to secure this gentleman as Mentor to their scientific wanderings will find their intellectual palate wonderfully stimulated by the *sauce piquante* with which the dryest items are presented.



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EDISON IN THE ORE-MILLING DEPARTMENT.

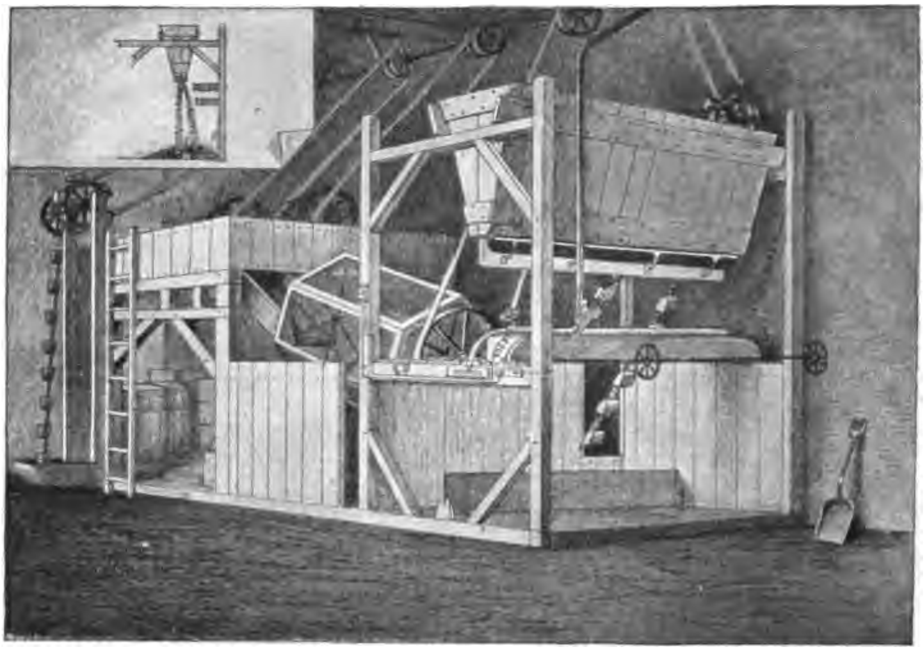
PHOTO BY W. K. L. DICKSON

THE GALVANOMETER DEPARTMENT.

Next in order come the outbuildings, devoted to ore-milling experiments, and the supplementary sheds, wherein are stacked an extensive collection of barrels, boxes, kegs containing gold, silver, copper and iron ores brought from all parts of the world. The majority of these have been subjected to the most rigorous treatment and supplied with their proper name and number. Thousands of similar samples in smaller packages are stacked in one of the upper rooms of the main building, known as the experimental ore-milling department, and in this room, which is fully equipped with crushers, rolls, assay furnaces, etc., Mr. Edison may often be found testing ores and washing gold with all the zest of a Western pioneer.

In this connection we shall treat of the magnetic ore separators, a valuable branch of electrical mining, which has received

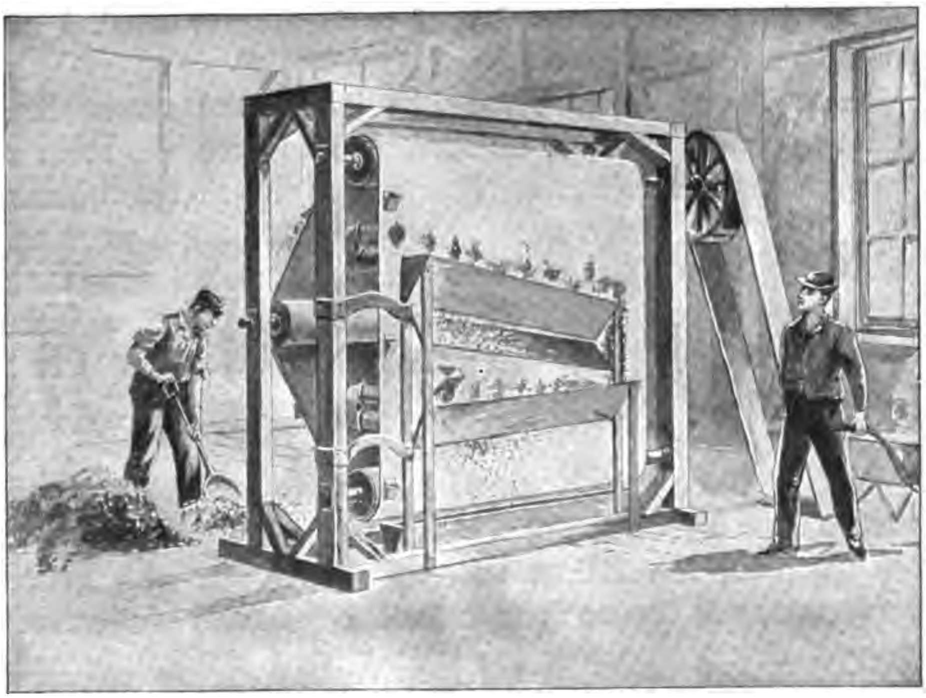
most careful and successful attention. Two special types of these ore milling machines are in operation at the Ogden, N. J., mines. The machine used in the primary process is most equable in its results, has no wearing parts, and is endowed with great capacity, reasons which render it peculiarly efficient in the rough separation of the lean, low grade ores. It is a sight to witness some



THE EDISON MAGNETIC ORE SEPARATOR.

five or six of these monster magnets, no contemptible rivals of Sinbad's wonder-working rock, bending their mysterious energies towards the extraction of the metal. The upper hoppers of the machine, when filled with the ore, are opened below, and a perfect Niagara of particles half an inch wide and thirty feet in length is allowed to rush past the magnets without touching their faces. In this downward progress a large proportion of the ore, being magnetic, is drawn inward, changing the trajectory

and bringing two distinct streams into view, the ultimate destination of which is secured by means of separate partition boards. The clouds of dust are caught up by fans and whirled away to closed compartments, where specially constructed dust separators are employed to extract the float iron.



THE EDISON–DICKSON REFINING MAGNETIC ORE SEPARATOR.

The next process is to recrush the magnetic part, which has been drawn into the inner receptacle, by passing it through a series of rolls and reducing it to the semblance of ordinary coarse-grained gunpowder. It is then fed against the second type of magnetic ore separator or refining machine, inclined rows of magnets being held rigidly in place at a certain angle, while a swiftly traveling belt, eight feet wide and over thirty

feet long, is made to pass up and over the face of these magnets, tumbling and whirling the mass of particles which is thus cleansed by successive stages until it has reached the last magnet on the upper row, where the residuum is caught up in buckets, attached three feet apart to the belt, and thrown over the back of the machine into a suitable receptacle. A large number of these magnetic separators are in use at the Ogden mines, where 5000 tons a day of crude ore are crushed and magnetically concentrated.

The Orange laboratory, despite its pastoral surroundings and the pacific nature of its habitués, has been the scene of some gruesome experiments. The question of capital punishment, by means of electricity, was forcibly agitated several years ago, and the opinion of the world's leading electrical expert was naturally sought. When the new law was passed, enlisting electricity as an agent of death, Mr. Edison was consulted as to the best method of applying that mysterious and deadly fluid. To this he replied:

"Hire the criminals out as linemen to some of the New York electric light companies."

Later on, Mr. Edison took up the subject with greater seriousness, and became more and more convinced of the superiority of electrocution over any other method of inflicting death. He tested the comparative action of the straight and alternating currents at different intensities, and arrived at the conclusion that from twelve to fifteen hundred volts alternating current would be sufficient to induce swift and painless release. In the attainment of these views not only were many painful executions necessary, but Mr. Edison's friend and assistant, Charles Batchelor, barely escaped the distinction of officiating as a sacrifice on the altar of experimental science.

One of the executions alluded to was in process of completion and to Mr. Batchelor had fallen the unpleasant task of head

PHOTO BY W. K. L. DICKSON

PART OF THE EDISON CONCENTRATING WORKS AT EDISON, N. J.

executioner. It was desired to secure an alternating current, and as the gigantic dynamos in use at the laboratory furnished only a continuous current, Mr. Batchelor was reduced to the necessity of attaching an alternating device to an electric generator, used for the illumination of the streets near the establishment, and developing a current of twelve hundred volts. To this dynamo two wires were attached, one linked with a sheet of tin lying on the ground, and the other wire placed in a basin of water in close proximity to the tin. These preparations completed, the poor little mongrel, selected for scientific exposition, was conducted to the spot, where he behaved in a fashion totally unworthy of the distinction bestowed upon him. A due regard for the "eternal fitness of things" should have led him to take up his position on the sheet of tin, so thoughtfully provided, partake of the water and yield incontinently to the impulse destined to land his shade in the regions of the Dog Star, or whatever the celestial hunting fields may be, devoted to the reception of beatified canines. A perfect circuit would thus have been provided, leading from the lips and tongue of the little beast, through his head and body to his legs, and an impetus would have been administered warranted to secure that hitchless locomotion so dear to the heart of projectors. Unfortunately, the dog, an animal of low and unprogressive views, refused to lend itself to the development of science, backed from the tin rostrum and rejected the water, reducing the executioners to the ignominious necessity of pulling him violently into position by means of the rope attached to his miserable little neck. Once in contact with the water, however, the results were instantaneous; the slightest possible twitching of the muscles was apparent, but beyond this there was no cry or anything to indicate suffering.

It was at about this time that Mr. Batchelor had his narrow escape. He was mending some defective apparatus in connec-

tion with a lamp and, as it seemed to him at the time, had taken all imaginary precautions against an accident. He supposes, however, from the presence of a burn afterward found on one of his fingers, that he must unconsciously have established a circuit by holding a wire in each hand. No sooner had he made contact than he staggered back to a stool, with the awful memory of soul and body wrenched violently asunder, with such pangs as the Mahometan death angels wreak on the awakening spirits of the damned. He describes it as resembling the sensations of an immense rough file thrust through the quivering fibres of the body, a shuddering, rasping pang, grinding its way through lungs and heart. For over fifteen minutes he sat motionless, bathed in an icy and deathlike sweat, and nervously unstrung from head to foot. Yet, strange to say, the shock passed away in a day or two, leaving no visible injury except in the memory of the victim.

It is possible that this recuperative power may be due to Mr. Batchelor's perfection of physique. A man of less mental and physical stamina would probably have borne the traces of this adventure for the rest of his days, even supposing him sufficiently fortunate to escape with his life. No alternating apparatus was attached to the dynamos on this occasion. But for this fact, it is possible that Mr. Batchelor would be engaged at this moment investigating spiritual causes instead of the cruder material effects to which he has so long devoted his powers.

Mr. Edison, like many of his intellectual compeers, is personally averse to capital punishment, and regards its infliction as a relic of barbarism, destined to disappear with the advance of civilization. He believes in the most stringent restraints and in the cultivation of every social force qualified to modify or extirpate evil, but he thinks these ends may be attained by incarceration—life-long if necessary. The terrors of protracted

and solitary confinement will act as sufficient deterrents on the baser types of humanity, while those capable of better things can have their thoughts diverted into purer and more useful channels, in the selection of such work as seems best suited to their capabilities.

"There are wonderful possibilities in each human soul," said Mr. Edison, "and I cannot endorse a method of punishment which destroys the last chance of usefulness."

With these decided views, and with every humane instinct on the side of the suffering brute creation, it may be imagined that Mr. Edison's sympathies were only partially enlisted in the development of these ideas. It was only in the recognition of capital punishment as a necessary evil, and in the desire to render its infliction as painless as possible, that the inventor lent himself to the task of investigation. The commission appointed by the State of New York to test the efficiency of the proposed methods was permitted to use a building in the rear of the Orange laboratory and supplied with electrical appliances, together with the assistance of skilled members of Mr. Edison's staff, notably Mr. A. E. Kennelly. The application of the fluid was relegated to Dr. Carlos F. MacDonald, medical superintendent of the Auburn Asylum for Insane Criminals, assisted by Dr. A. D. Rockwell, one of the most noted electricians of our age; Dr. Edward Tatum, of the University of Pennsylvania, and Mr. Harold P. Brown, electrical expert, by appointment of the State. The points for decision were the kind of current to be employed, the amount of destructive force necessary, and the place of application. Four dogs, a horse and four calves were provided for the purposes of investigation. The first practical exposition of these kindred experiments was far from successful, but later tests brought unsuspected facts into view, and electrocution is steadily winning precedence as the least objectionable form of judicial killing.

A miniature edition of the Orange laboratory is the building at Fort Meyers, Fla., erected for the entertainment of the inventor, whose ideas of relaxation are much on a par with those of that active female who requested her spouse to cut up

PHOTO BY W. K. L. DICKSON

SAMUEL EDISON IN HIS FLORIDA FLOWER GARDEN.

a cord of wood while he was resting. But for the salutary outlet which such establishments afford, there is reason to believe that Mr. Edison would suffer from a veritable plethora of ideas, and perish eventually with intellectual apoplexy. As it is, he has been enabled to ultimate his thoughts under conditions highly favorable to mental development. The laboratory

is excellently equipped, though necessarily upon a less sumptuous scale than the parent establishment. It is supplied with dynamos, steam engine and boiler, shafting, lathes, drill-presses and planers, scales, electrical measuring instruments and all other needful tools. The chemical department is very complete; running water is supplied from a large tank on the roof, being pumped up from a deep well by means of a windmill. A gas generating apparatus is also comprised in the fittings of the department.

A roomy house of the Queen Anne style stands within easy proximity to the laboratory, and is supplied with every convenience which the heart of reasonable man could desire. It commands a wide prospect of flowering gardens, studded with tropical palms, through the soft vistas of which the crinkled silver of the Calahoutchie river may be seen. Samuel Edison, the father of the inventor, and Mr. James Symington, a friend of thirty-seven years standing, spend the greater part of each winter in this congenial resort, and are triumphant vindications of its peaceful and salubrious influences. Mr. Edison, Sr., in particular, exhibits a mental acuteness and physical energy which furnish a singular contrast to the self-indulgent humanity of the day. He relegates to no one the task of cultivating these domains, and may be seen at early dawn, as well as during the hottest hours of the day, tilling the ground in true patriarchal fashion.

A more easy-going, contented, not to say lazy and lethargic, spot than Fort Myers it would be impossible to find outside the geographical limits of Lotus Land. To these pleasing qualities is due the present condition of street lighting at the Fort. Thomas Edison, on the occasion of one of his flying trips, undertaken for hygienic reasons, offered to furnish Meyers with a system of electric lighting, provided the Meyerites would furnish the poles. This handsome proposition, at which any

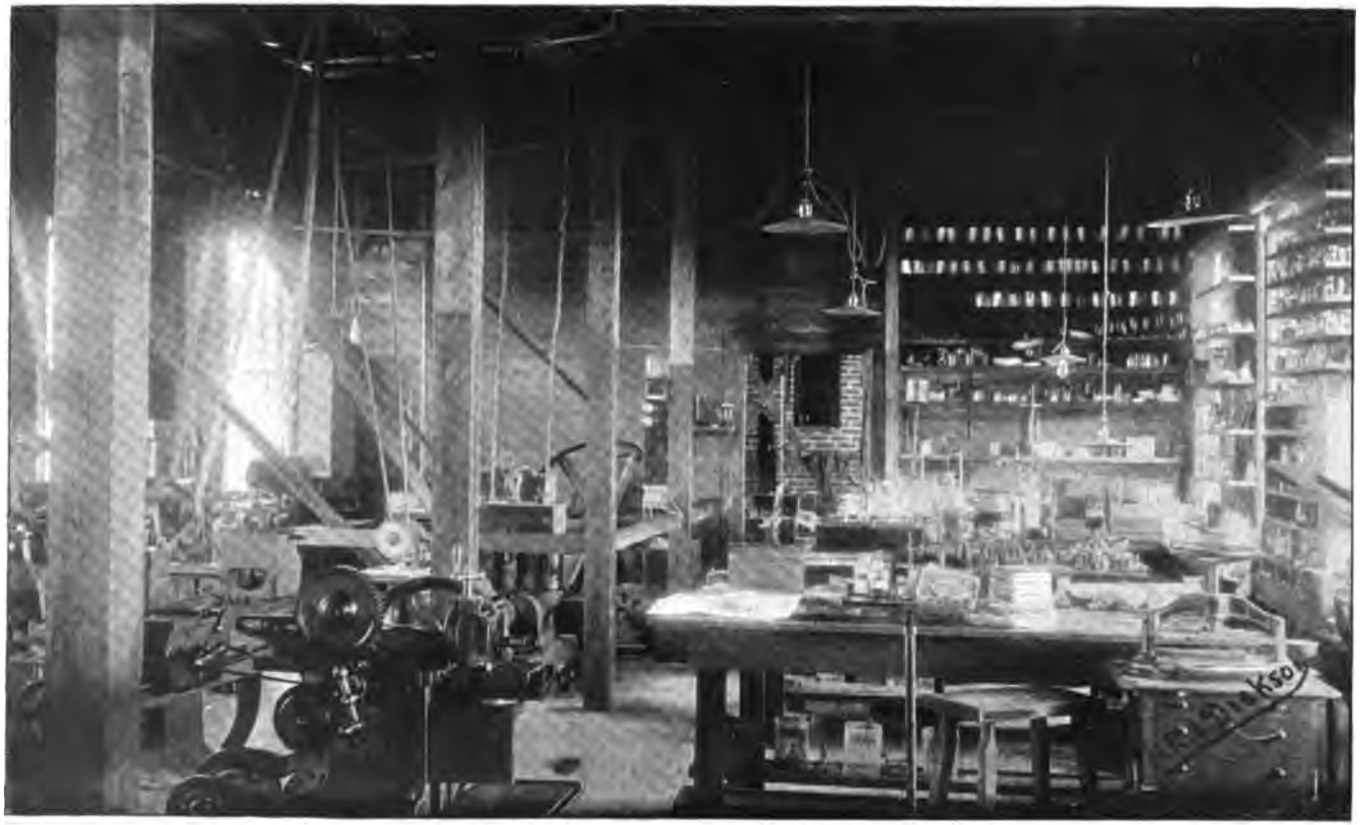
corporation with a modicum of enterprise would have jumped, was languidly refused, and Mr. Edison, disgusted with the lethargy of his beneficiaries, left them to the time-honored radiance of a tropical moon and the phosphorescent lights of the Calahoutchie river. The latter phenomenon is curious and beautiful enough to furnish some excuse for the contemplative indolence of the natives.

> " Watching
> . . . The crisping ripples on the beach
> And tender curving lines of creamy spray,"

we become aware of the most exquisite and varied effects of phosphorescent light. The teeming myriads of fish, large and small, which vivify these busy waters, describe their erratic orbits in paths of fire, and every stroke of the oarsman gives birth to new combinations of tinted radiance. To cross the river, on a dark and stormy night, with the deadly scimetars of Uranus unsheathed overhead, and a sea of molten fire beneath the slender protection of the craft; to watch the great tarpons plunging in their lurid trail; and their finny subjects climbing the illumined crests of the waves; to hear the gathering forces of the tempest, voiced in swirling waters and crashing thunder, these are experiences not readily to be forgotten. Nor is the softer side of nature less indelibly impressed upon the mind. The fairest and most unsullied dawns are those which succeed the travail of Creation's Night.

> "Morn in the white wake of the morning Star
> Comes furrowing all the Orient into gold."

The rain-drops on grass and tree sparkle with all the sheen and hue of Elfin regalia, and the winds, laden with rich argosies of scents, sigh amorously among the tinted bloom. Air, water and earth are quivering with intensity of life, for the



EDISON'S FLORIDA LABORATORY.

denizens of this portion of the world have no time to spare, and borrow nothing from the inertia of their featherless, furless and finless neighbors. On all sides may be heard the whirr of wings, the stroke of fins, the scurry of tiny feet. There stands a spoonbill at the water's edge, the sunlight playing on his rose-tipped pinions. He surveys the floating market with the air of a bird well abreast of the times and conscious of the distinction of being born with a spoon in his mouth, albeit unwrought of precious metals. Farther up the bank, peering between the folds of grayish moss, an alligator protrudes his gnarled surface. He looks evil and unlovely enough to have stepped out of a prehistoric frame, and his expression betokens sour disapproval of the post-diluvian frivolities which encompass him. But Beauty, "drunk with the sweet sap of the Earth Life," controls the hour and laughs at his stagnant and forbidding mien. The paroquets flaunt their crimson and emerald crests; the azure-coated jays pursue their parliamentary disputes; the snows of the plume-bird and the richly ensanguined hues of the cardinal glow in the tropical sun; butterflies flash and glitter; beetles speed past in their jewelled mail. A bevy of ruby-throated humming-birds are balancing themselves unconcernedly on a spray of creamy blossoms, intoning their hymn of deep content, and sipping Dionysian dews from chalices, more rarely hued and fashioned than Nero's murrhine vase.

Great masses of tinted bloom, rose, amber, ivory, azure and gold, lend their varied charm to the general scheme of color, which is as dazzling as it is harmonious, and which yields, with each passing moment, to new kaleidoscopic forms. Gazing at this lovely scene, we are conscious of a growing leniency towards the non-progressive tendencies of the inhabitants, and our senses, attuned to the soft harmonies of nature, shrink from the contemplation of that rude clamor which attends the onward march of civilization.

Wistfully we murmur:

> "How sweet it were, hearing the downward stream
> With half-shut eyes, ever to seem
> Falling asleep in a half dream."

But it may not be, and summoning our truant senses, we indulge in one of those rapid flights, familiar only to poets and dreamers, and alight at the beautiful domains of Edison's northern home, Glenmont.

CHAPTER XXIV.

GLENMONT. THE CHÂTELAINE. THE ENTRANCE HALL, LIBRARY AND DEN. REMINISCENCES OF THE PARIS EXPOSITION. RECEPTION ROOMS. A PEEP INTO FAIRYLAND. THE HOME CIRCLE AT GLENMONT. THE END.

EDISON'S Northern home, Glenmont, in New Jersey, consists of an extensive and superbly appointed house, built of brick, stone and wood, in the most unexceptionable style, and surrounded by well-kept grounds. Refreshingly independent of architectural rules, it yet presents a wealth of fancy, which brings into view at every turn unguessed and delightful surprises. It abounds in gablèd roofs, picturesque nooks and angles, carved balconies and mellow sheets of stained glass, the whole set in a panorama of rare shrubs, floral arabesques and beds of emerald velvet, the brilliant coloring of which is thrown into broad relief by a background of sombre pines.

A porte-cochère admits our vehicle and ourselves into a paved enclosure. Mounting the steps, we are ushered into the entrance hall, which, after the fashion of English manors, is luxuriously furnished, and serves as a general lounging place, rather than as a mere passage for ingress and egress. Red mahogany, cunningly wrought, enters into the composition of floor, walls and ceiling, affording an effective background for the glowing Eastern fabrics which abound. The furniture is upholstered in leather of a dusky crimson hue. An old-time

PHOTO BY W. K. L. DICKSON

GLENMONT, EDISON'S HOME.

fireplace has its appropriate burden of logs and massive andirons, and is surmounted by a suit of knightly armor. A lordly staircase of polished mahogany faces the front entrance, on the first landing of which is an immense casement of stained glass, the rainbow hues of which float down to us in a species of glorified mist. On the right of this entrance hall is the

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THE LIBRARY.

library, containing many exquisite pieces of statuary, bronze and marble, together with a few choice paintings, among them an excellent copy of Guido Reni's "Aurora," Sauvage's "Méditation," and a life bust of Mr. Edison himself. Stained glass is also used in the room, and with considerable effect, sufficient light being admitted for purposes of study, without necessitating the garish glare attendant on the untempered daylight.

PHOTO BY W. K. L. DICKSON

EDISON'S DEN.

Re-entering the hall, we cast our eyes on the massive staircase which faces the front portal, and are aware of a most lovely vision, none other than the châtelaine of these fair domains. The jeweled tints from the great cathedral window fall on her queenly head, crowned with its aureole of nut-brown hair; draperies of pearl and silver cling softly to her lissome shape, at her feet lie the royal webs from Indian and Persian looms, and about her cluster the masses of radiant bloom. Greetings exchanged, we mount a short flight of steps, facing the entrance, and pass into the dining room, rich with carvings of oak and mahogany, hunting and pastoral scenes, and heavy with the breath of flowers.

Back of this is Mr. Edison's "den," than which no spot was ever less suggestive of its name. Nor does the task of "beard-

ing the lion in his den, the Douglass in his lair," call for any special display of prowess. That individual, ensconced in the recesses of a deep arm-chair, and screened behind the pages of a New York periodical, turns on us a face so luminous with good nature and kindly humor, as to have enlisted the affections of any, less familiar than we were, with his most lovable personality. We content ourselves with a warm grasp of both hands, in itself a vital tonic, for the inventor is a prey to one of his rare indispositions, and as he tells us, laughing, is "chockful of quinine." The drug has heightened his natural infirmity of deafness, and not until we aroused him, had he been aware of our presence. It is pathetic beyond expression to see this man, to whom we owe such an immeasurable debt in the

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THE DRAWING ROOM.

PHOTO BY W. K. L. DICKSON

A CORNER IN THE DRAWING ROOM.

extension of our physical powers, patiently enduring the isolation which must be attendant on this dark and soundless prison, a stranger to all the sweet and interior harmonies which underlie the cadences of Nature's orchestral symphony.

The "den" is not what the title might suggest—a narrow

cage, devoted to pessimistic soliloquies. It seems rather a general lounging place for the family, whose occupations are indicated in a variety of ways. Here is a Weber piano, full-toned and sweet; there is an organette or mechanical organ, a magic lantern with arrangements for exhibiting a superb collection of colored and uncolored views; a phonograph and several revolving bookcases, well filled with scientific books of reference. On

DRAWING AND RECEPTION ROOM VIEWS.

the mantle-piece, which, like the other fittings of the room, is of white mahogany, are several ornaments, which possess a peculiar personal interest, in addition to their intrinsic value. Foremost among these are the statues of serpentine marble, gifts of the Russian Emperor; the quaint Japanese vases, presented by the Society of Engineers of Japan; and the Krupp inkstand, a present from the bellicose manufacturer, and probably the most unique appliance of the kind. It consists of a collec-

OFF FOR A DRIVE.

tion of miniature guns and shells, made of Krupp steel, the ink wells being constructed of shells, while a heavy siege gun supports the penwiper, being elevated and depressed at will in the same manner as its martial prototype. Half a shell receives the pens, and the tall candle-sticks which guard the outposts are made in the form of "Long Toms," the whole presenting a *tout ensemble* sufficiently realistic to find place in the War Department of Lilliputia. It is significant to see this triumph of the pen over steel, and to note the docile way in which these grim servants of Ares lend themselves to the furtherance of the despised scrivener's craft.

MADELINE AND CHARLES.

In a bay window we ensconced ourselves with the hostess for the better contemplation of Mr. Edison's medals and decorations, which were effectively displayed on a background of black velvet. These comprise, among others, the Prince Albert gold medal, from the London Society of Arts (1892); the three degrees of the Legion of Honor—officer, chevalier and commander; the bronze medal of the Photographic Society of France, conferred in connection with the kinetograph; the

Order of Commander of the Crown of Italy; medals from the American Institutes of Boston and New York; from the expositions of Sydney (1879), Melbourne (1889), Milan (gold), Crystal Palace (1882, silver), and Paris (1879 and 1889).

MADELINE.

There is also a cigar case from the Emperor of Russia, enameled in fervid blues, scarlets and gold, and embellished with an inscription, presumably of an affectionate and personal nature, but which, to the eye of the uninitiate, simply present an aggregation of trip-hammers and other unintelligible signs. Having sufficiently examined these international tributes, we apply ourselves to the perusal of a very interesting scrap-book, compiled of autograph letters, relating to the trip undertaken by Mr. and Mrs. Edison to the Paris Exposition of 1889. Here is a letter from Madame Carnot, couched in

MRS. EDISON.

pretty foreign English, placing the Presidential opera box at "Monsieur and Madame Edison's" disposal.

The reception was as sumptuous as it was unexpected. Three boxes had been thrown into one, the house was hung with American flags and national colors, and as the party

A CIGAR CASE, A RUSSIAN GIFT TO EDISON.

entered the orchestra struck up the national anthem of America. The inventor's visit was productive of the wildest enthusiasm, which made itself especially felt on the occasion of a Spanish concert, given in the French metropolis. As soon as it was over, the audience left precipitately, and when the Edison party entered the brilliantly lighted boulevard they found themselves surrounded by a dense throng shouting "Vive Edison."

A PROUD PAPA.

Among the numerous invitations comprised in the book, we notice one from Buffalo Bill, signed by some of the invited guests, Ada Rehan, Whitelaw Reid, Chauncey Depew and A. Anderson, artist of the painting "After the Ball," which, together with a rude cross affixed by the celebrated Indian chief Rocky Bear, surmounts the grand staircase at Glenmont.

AT THE GLENMONT CONSERVATORY.

A visit to Pasteur was paid, and full facilities for examining his process of inoculation were afforded. In the Eiffel tower they met many celebrities, among others the composer Gounod, whose gift of an impromptu musical effort we noted with interest. The party were entertained by the *Figaro* in royal, rather than republican, style, and they also assisted at the civic

ENTRANCE TO LLEWELLYN PARK, EDISON'S HOME.

banquet, composed of the assembled mayors of France, a platform of honor being reserved for the iuventor and his suite.

From the Queen of Italy we notice the following message, phonographically received by Mr. Edison immediately upon his arrival in Europe: "Women everywhere owe to Mr. Edison a deep debt of gratitude for giving them the means of bringing near to them the very voices of loved ones who are far away."

The mellow chiming of a distant clock reminds us of the passage of time and the extent to which we have trespassed on our hostess' leisure. We therefore emerge somewhat reluctantly from our downy nest and proceed to the examination of the reception rooms, after a lingering glance at the den ceiling, which is painted by Tojetti, and set about with curious devices of glass, somewhat resembling the shining scales of the tarpon. The front reception room is garbed in no dominant tint or

style, but abounds in artistic surprises. In this room, as in the entire house, stained glass is used, and exquisite are the effects produced by these molten gems. The drawing-room retains the same guise of fanciful grace as the reception room, and is in open rebellion to the imposition of stiff, archaic rules. Up stairs, the first room entered, is Mrs. Edison's private sitting room, fronting on the lawn and presenting a fascinating medley of knick-nacks, photographs, pictures, flowers and draperies.

A GLADE IN THE PARK.

We pass in succession through a number of exquisite rooms, carpeted in rich-hued velvets. There are many of these reception chambers, all fitted up in the same delicate hues, the ceilings painted with designs of flowers and Cupids, after the joyous French fashion. The boudoir opening from the west bedroom seems like nothing in the world but a magnified bonbonnière in enamel and gold.

Boudoir is a term derived from the French "bouder," to sulk, and these minute penetralia were originally provided for the indulgence of my lady's vapors; but it is difficult to associate gloom with the rose-colored atmosphere of this Elfin bower.

The topmost floor is devoted to the accommodation of the younger olive branches and their nurses, and is as cosy and liberal in its arrangements as the heart of child could demand. The joint department, consecrated to Messrs. Tom and William, was surprisingly neat, and betrayed its occupancy only by a litter of paints and brushes.

A WINTER SCENE.

Pausing for a glimpse at the billiard room, which is also located on this floor, we descend the stairs on our way out. As we emerge into the hall a patter of little feet greeted us, and two little elves, known in mortal land by the names of Madeline and Charles, flee into their mother's arms. Madeline has much to tell respecting the inclement conditions of the weather, and how the wind being cold, she has wrapped the dolly in furs and hood. Do we think "Charmante" will catch cold, she asks us anxiously, and we assure her with all proper gravity that she has probably averted that catastrophe by her timely precautions. Dear little mother heart! Charles in the meantime has responded to the inquiry whether he could still turn a somersault, by a sudden

ONE OF THE DRIVEWAYS IN THE PARK.

and alarming inversion of his person, and a wild attempt to balance himself on the top of his head, an acrobatic feat which he repeats several times, despite his mother's mild remonstrances, and the consequences to his attire. When he came up after one of these ineffectual attempts, flushed, tired, but totally undaunted,

A VIEW FROM EAGLE ROCK, NEAR ORANGE.

with his eyes sparkling and his lovely, childish face all aglow with fun and determination, it was easy to trace the mimic reflection of those characteristics which have furnished the basis of Edison's successful career.

Edison's purchase of Glenmont constituted a ten days' wonder to those acquainted with his rough and tumble ways and his utter disregard of luxury. That a nature, whose domestic requirements had hitherto been met by the most prosaic of surroundings, should suddenly develop a necessity for the very blossoming of æsthetic art, was indeed calculated to excite popular comment, but the inventor's selection was universally commended as a suitable shrine for his young and lovely wife. As a general rule, votaries of Hymen are launched into the gulf of matrimony with little protection against the jars and shocks which attend their descent, but in this instance the

celestial powers were kind enough to provide a stepping stone for the future Mrs. Edison in the shape of a parent endowed with decided mechanical abilities, the inventor of a mowing and reaping machine and other practical contributions to agriculture. To her early familiarity with the eccentricities of genius, and

A LAKE IN LLEWELLYN PARK.

to the possession of a singularly placid nature, is due the serenity with which the girl wife has applied herself to the solution of her marital problems and the adaptability which she has displayed in regard to her husband's exacting career.

Our task is accomplished, rudely and imperfectly, but with such wisdom and conscientiousness as we have been able to command. A life so varied, and bearing so extensively on the inventive side of existence, has been felt to embody materials too voluminous for exhaustive treatment. It has been judged

best to present the salient characteristics and achievements of the man, rather than a minute and wearisome collection of details. A semi-scientific biography, like the one in hand, is unable to meet individual requirements and must limit itself to the establishment of a general platform of ideas. Patent reports and technical books are accessible to specialists, desiring to make a minute study of separate inventions, and it has been thought wiser to convey the general substance of Edison's personal and scientific career rather than to confuse the ordinary intelligence with what, except to the initiate, might resolve itself into a mass of crude and undigested information, somewhat after the order of Dickens' graduate, whose scholastic equipment consisted of a multiplicity of facts so tightly packed as to be totally inaccessible.

Possibly, at the close of a decade or two, if the great inventor and his chroniclers have not been removed to the higher schools of Wisdom, Edison's later achievements may be placed before the public. That he is on the threshold of vaster discoveries than have yet been given to the world is guaranteed by his early promise, his unquenched genius and his splendid and untainted physique.

L'ENVOI.

The nineteenth century is verging toward the sunset of its years.

> "The Western skies are all ablaze
> With lines of ruby, gold and chrysoprase."

As we run to and fro on our feverish quests for fame and glory, we may read, if we will, the signs of the coming morning, plainly set forth in those jeweled scrolls; for the promise and potency of the Future lie in the Past and Present, as the divine Life slumbered in the swaddling clothes of the Babe of Bethlehem.

In the true relation of the sexes lies the solution of every problem, intellectual and moral, which has baffled the sundered halves of this great human Unit. What though the pendulum of feeling has oscillated too far; what though the argent and samite of shield and banner be soiled with jealousy and strife, and the discordant challenge of "rivalry" has usurped the rallying cries of "Union and Co-operation?" The pendulum will swing into its true position, the sundered hosts will unite, and what shall the force of sin and ignorance avail against that mighty alliance! Marriage shall be lifted from the slough of sensuality and freed from the shackles of tyranny and submission. From this union of minds, individual and racial, achieved by the junction of woman's perceptive wisdom with the rational wisdom of the man, and welded in the fire of a love, sweeter and more passionate than the Epithalamium of the morning stars, shall be born new forms of social and

political life, such as are undreamt of by the maimed and halting sections of divorced humanity.

It is vain to oppose the splendid sweep of the spiritual tides; better to float in the currents of the divine life, than to ply our fragile oars up stream, and to pit our puny strength against those health-giving and potential billows. The time will surely come when man and woman, standing side by side and hand in hand upon the broad and sunlit heights of human progress, shall look back upon the narrow and crooked paths, the tangled thickets, the miasmic swamps, the rock-hewn tombs and Golgothas, through which they have so painfully forced their way, and as they gaze, their gratitude will not be withheld from the man who, in his own peculiar line of thought, has done more than any other to neutralize the gross fixity of matter, to extend the limited range of the senses, and to furnish a plastic basis for the incoming spiritual forces, "the greatest genius of this or any other age," THOMAS ALVA EDISON.